ELECTRICAL REVIEW

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VIEWS, NEWS AND INTERVIEWS.

According to one of our London contemporaries, the text of the first message sent across the English Channel by the Marconi system was: "VVV are you there VVV?" In England they do not say "Hello" over the telephone—that word being considered impolite—but always "Are you there?"

The course in applied electricity at the Johns Hopkins University, Baltimore, Md., will be abandoned at the end of the present term, owing to a lack of available funds to carry on the work of the department. The institution has been suffering from a lack of money for some time, and it has been found impossible to carry on the work properly or to purchase new instruments. Dr. Louis Duncan, who has been at the head of the electrical department ever since its inauguration in 1886, has already sent in his resignation as a member of the university staff. Dr. Duncan is now on a leave of absence, being employed as consulting engineer by the Third Avenue Railroad Company in New York city. During Dr. Duncan's absence Dr. Cary T. Hutchinson has been in charge of the electrical course.

General Greely, of the Signal Service of the army, has received a report from Maj. Richard E. Thompson, chief signal officer with the troops operating in the Philippines, in regard to the telephone and telegraph lines built and operated by his command. Major Thompson says that the telephone system is close to the fighting line. This allows orders to be sent directly to the front, and information gathered by scouts can be communicated directly, with the loss of little time, to the commanders of the separate divisions. The system of permanent telegraph lines is in perfect order and connects with the telephone lines at suitable points where stations have been established, and mounted messengers are kept in readiness for immediate service. The whole system centers in Manila, and General Otis, as a rule, is within 15 minutes of any of his officers, no matter how near they may be to the enemy. General Greely says that the signal system in the Philippines is the most extensive ever used in any warfare.

A cable dispatch states that the rise in the price of copper is seriously affecting the English midland industries. The Kynoch company, of Birmingham, manufacturers of arms, munitions, etc., have discharged over 1,000 hands, and the remainder of the employés of the factory are working half time. The government has ceased placing orders for copper, and the electrical firms are greatly hampered in filling orders for which contracts were made some time ago, based on a low price of copper.

Speaking at the dinner of the Institution of Mechanical Engineers in London on April 26, Rear-Admiral Lord Charles Beresford said that Great Britain was much behind the United States and Japan in the use of electricity as a motive power aboard warships. He had been amazed to see the great use of electricity aboard of American warships, it being employed where the British still used steam. The American vessels were consequently far cooler than the British.

It is reported that a decision has been reached concerning the Pacific cable. The British Government has decided to contribute in the form of a yearly subsidy the full amount recommended by the committee which examined the matter in 1896, to guarantee the construction of an all-British line by way of Vancouver, Fanning Island, Fiji, Norfolk Island, Queensland and New Zealand. The capital stock of the enterprise has been divided into 18 parts. Of this it is said that the colonies of Australia and New Zealand will take eight-eighteenths, and the government of Great Britain and the Dominion of Canada five-eighteenths each. The work of laying the cable will begin this Summer.

The Hartford, Ct., Street Railway Company is trying an experiment in the rapid and frequent delivery and collection of mail matter in the territory covered by its numerous lines. On trolley cars running about half an hour apart a miniature mail box is attached to the rear platform guard, and on the car roof is carried a sign "U. S. Mail." Passengers traveling on the cars or residents along the road may deposit mail matter in these boxes, which is collected by a post office messenger at a central meeting point in the city of Hartford, near the post office. The experiment seems to be a success.

"PICTURES BY TELEGRAPH"—A PORTRAIT (ONE-HALF ORIGINAL SCALE) RECEIVED AT NEW YORK FROM ST. LOUIS OVER 1,550 MILES OF LINE AND ONE REPEATER. REPRODUCED WITHOUT RETOUCHING.

The record for long-distance practical telegraphing was broken on April 25 by the Associated Press. A continuous circuit of 6,001 miles, reaching from New York city to the Pacific Coast and from Chicago to New Orleans, touching Philadelphia, Pittsburgh, Cincinnati, Atlanta, Memphis, St. Louis and Kansas City, Omaha, Denver, San Francisco and all the larger intermediate points South and West, was successfully worked for several hours. There were 41 operators copying from a sender in New York, with newspapers being served directly from this one circuit in 38 of the leading cities of the United States.

PICTURES BY TELEGRAPH.

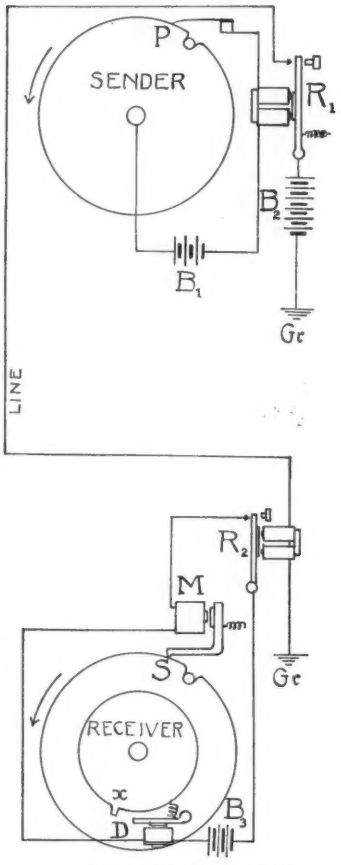
THE TELEDIAGRAPH—A NEW SYSTEM FOR SENDING DRAWINGS BY MEANS OF ELECTRICITY.

The attention of inventors has been attracted for many years—almost since the beginning of telegraphy—to the interesting problem of sending drawings or pictures by telegraph. The various methods that have been proposed have all depended upon the synchronism of apparatus at the two ends of the line, and the difficulty of obtaining this has been the principal cause for the lack of success of the older systems of picture telegraphy. The systems of Bain and Cassini, in which pendulums, running in exact synchronism at the sending and receiving stations were used, are familiar to all. In the new system, called the telediagraph, described below, the method is the same, but the mechanical details are different from anything hitherto proposed, and are made more interesting by the great success of the machines in practical operation.

Upon a circuit connecting the cities of St. Louis, Chicago, Philadelphia, New York and Boston, these machines have been installed in the offices of newspapers in each city. The illustrations here presented, and the privilege of seeing the apparatus at work, are due to the courtesy of the New York *Herald*, in whose offices in this city one of the machines is now in daily operation.

In the early experimental work of Mr. Ernest A. Hummel, the inventor, it was attempted to synchronize at the two ends of the transmission line the movement of platens or plates carrying at one end the drawing to be sent and at the other the paper upon which it was to be received. These platens were moved very much after the fashion of a planer bed, but, as might have been expected, serious mechanical difficulties interfered with the operation of the system. The present machines consist of cylinders of equal size at the two ends, driven by clockwork. At the sending end the drawing is made upon a piece of stout tinfoil in an insulating ink. This is

wrapped about its cylinder and turned under a platinum point, which makes contact with the tin-foil except where it crosses one of the lines of the ink drawing. At this point, of course, the circuit is interrupted momentarily. At the receiving end a similar cylinder, turning synchronously, has upon its surface a sheet of paper covered with carbon impression paper, outside of which is a sheet of thin semi-transparent paper, and the break-circuit signals operate a stylus which is



ELECTRICAL REVIEW N. Y.

FIG. 1.—"PICTURES BY TELEGRAPH"—DIAGRAM OF CONNECTIONS.

pressed down upon this surface, so producing the lines of the drawing.

The most interesting feature of the machine is the synchronizing method. This is of extreme simplicity, and inasmuch as it does not require the reversal of the line current or the superposition of any synchronizing current upon the main current, the instruments are capable of being duplexed or quadruplexed. Referring to the illustration, Fig. 1, the upper part of the drawing represents the sending apparatus in diagram. The tin-foil sheet bearing the drawing is fastened to the cylinder by a steel rod thrust into a score in its surface, after the manner of the old tin-foil phonograph. This cylinder is driven at a steady speed of about 14 revolutions per minute by clockwork, similar to an astronomical driving clock, and controlled by a Faraday wind-vane governor. The platinum point P bears lightly upon the surface, and is carried upon a carriage similar to that of a lathe. At each revolution of the sending cylinder, a pawl upon it engages in a ratchet upon the head of the carriage screw, and moves the platinum point forward by an amount dependent upon the pitch of the ratchet. There are four ratchets which can be set on the carriage screws of both receiving and sending instruments, and both the size of the cylinder to be used and the coarseness of the ratchet to be put in gear (upon which depends the speed of travel of the sending and receiving points) are agreed upon over the wire beforehand by ordinary telegraphic correspondence. In the circuit, with the platinum point and the cylinder of the sending apparatus, is a local battery of a few cells B_1 and a relay R_1. It will be observed that the system is a closed-circuit one, the relay R_1 opening only when the platinum point crosses a line of the drawing, or when it crosses the space occupied by the rod which holds on the tin-foil. This comparatively long break is used as the synchronizing signal. The impulses go out over the line and are received at the terminal station by the relay R_2. This relay works "backwards;" that is, it closes the local circuit of the battery B_3, the magnet M, and the detent magnet D, when the main line is opened. The receiving cylinder is arranged, by the adjustment of its clockwork, to run a very little faster than the sending cylinder, say one or two per cent. If both start with the break made by the fastening rod under their respective points, the receiving cylinder will gain a little on the sending cylinder, so that it will get around to one complete revolution first. At this point a small lug x is engaged by the lever of the detent magnet D, and the cylinder stops until the long break due to the point of the sending cylinder crossing the fastening slot releases it, when both cylinders start again. By this extremely simple means exact synchronism is secured at one point in each revolution, while the excellence of the clockwork prevents the cylinders from being noticeably out of step with one another during the remainder of the revolution.

The clockwork at each end is driven by a weight and an endless steel belt. A winding drum, operated by a small electric motor, winds up at each revolution enough of the slack to keep the apparatus constantly moving. When either the sending or receiving carriage has reached the end of its travel, an automatic stop throws the instrument out of circuit. In the instruments now in operation three sizes of cylinders are in use and four speeds of travel. With an intermediate speed the lines made by the stylus are close enough to merge into one another, giving a result similar to that shown on p. 273. This is reproduced directly from a picture sent from St. Louis to New York, over a circuit 1550 miles long, including one repeater, on the evening of April 26. With the cylinder running at 14 revolutions per minute, this picture was received in about 26 minutes. It will be seen that it is a perfectly recognizable portrait, and needs only a little retouching to fit it for reproduction. In recent tests of the machines it has been found possible to send a picture from any of the five cities named above and receive it simultaneously in the other four. The longest circuit over which the telediagraph has been successfully operated was from Key West, Fla., to New York, including 120 miles of cable and repeaters at Jacksonville and Richmond.

A great part of the credit of the successful operation of the instrument is due to Mr. Peter H. Flynn, who has been for many years in charge of the telegraph department of the New York *Herald*. It is interesting to note that the inventor, Mr. Hummel, is not an electrician, but an expert clock-maker. Much of the success of the system is due to the superb specimens of clockwork which he has made for driving the machines.

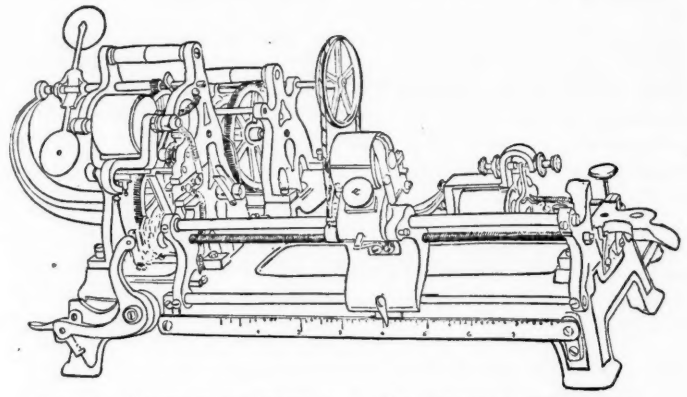


FIG. 2.—"PICTURES BY TELEGRAPH"—THE TELEDIAGRAPH RECEIVER.

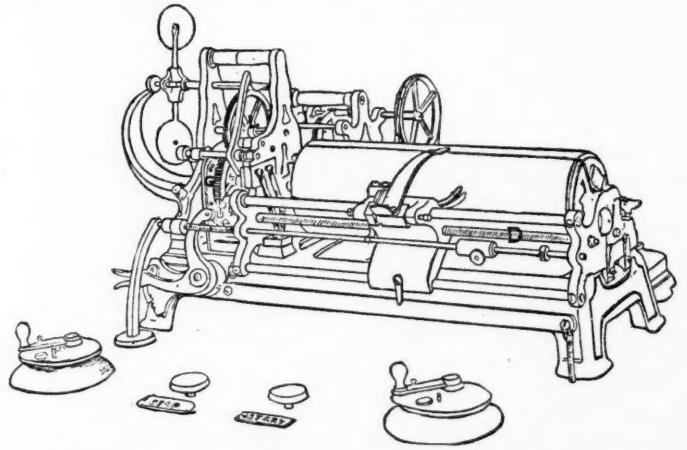


FIG. 3.—"PICTURES BY TELEGRAPH"—THE TELEDIAGRAPH SENDER.

The Association of Municipal Electricians.

The ELECTRICAL REVIEW is informed that arrangements have been made by which President McKinley will start the electrical exhibition to be held in the Cycle Academy, at Wilmington, Del., next September, during the convention of the Association of Municipal Electricians. The President will touch a button in the White House and start the machinery in motion.

ELECTRICITY IN THE MANUFACTURE OF CAUSTIC SODA.

THE RHODIN ELECTROLYTIC PROCESS IN AMERICA.

There is about to be added to the number of plants utilizing Sault Ste. Marie Falls a great installation for the manufacture of bleaching powder and caustic soda by the Rhodin electrolytic process. This method of decomposing common salt into its constituent elements is not, of course, different in principle from other electrolytic processes, but differs greatly in its details and presents many features of great interest.

The electric current passing through a solution of common salt liberates oxygen, chlorine and certain complex oxygen acids of chlorine at the anode. At the cathode metallic sodium and hydrogen are freed, but the sodium immediately enters into combination with the water present, making sodium hydroxide, or caustic soda, and more hydrogen.

This extremely simple process is attended with serious difficulties in practice. If it is attempted to electrolyze brine in an ordinary vessel, the chlorine liberated at the anode, and its oxygen compounds, dissolve in the solution and attack the caustic soda forming at the other pole, with the formation of chloride, chlorite, hypochlorite and other salts of soda. The product is vitiated and useless. To obviate this difficulty, electrolyzing cells having a porous partition were used. Again, difficulties of a serious nature were encountered. In cold water or aqueous solutions chlorine and its oxygen compounds are readily soluble. Chlorine is one of the most active elements known to chemistry, and its action upon the anode itself and the porous diaphragm was always violent and destructive. Further than this, the electrolysis of the brine seems to stop when a certain proportion of salt has been reduced, leaving the caustic product contaminated with salt.

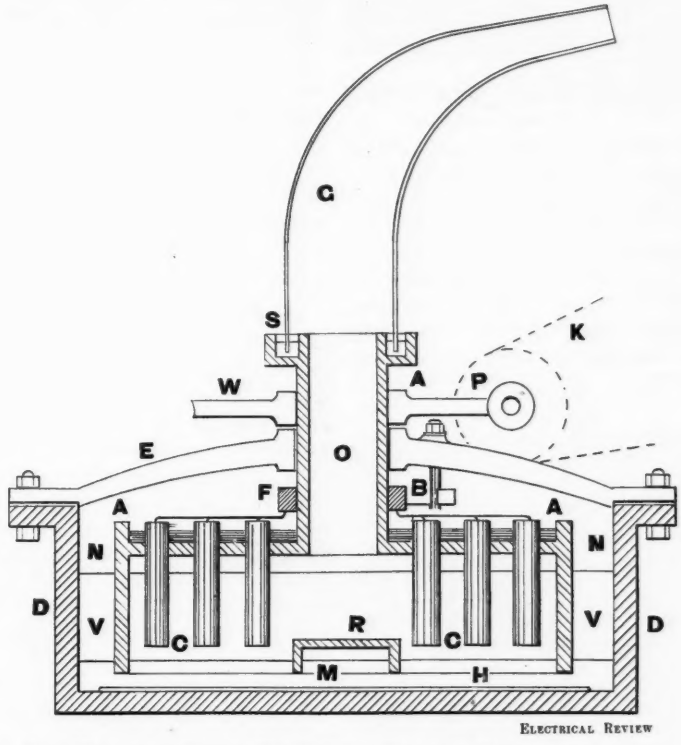
One of the first successful attempts was a process wherein mercury was used as the cathode. The sodium formed upon its surface is immediately amalgamated, and can be recovered by distilling the mercury. It is dissolved out as caustic soda, without loss of mercury, simply by exposing the latter to the action of water.

Mercury being a liquid body can easily be transferred from one portion of the cell to another, and lends itself very readily to the formation of a liquid and gas-tight seal which enables the cell to be separated conveniently into two different portions, the contents of which can not mix with each other.

In addition to this, where mercury is used as a negative pole, the current of electricity has never to pass through the caustic solution when the two sides of the cell are separated, but only through the thin layer of brine which forms the space between the positive pole and the surface of mercury, the transference of the amalgam from the negative pole immediately opposite the carbons to the other side of the cell where the sodium is to be removed by the water being accomplished very simply by the natural diffusion of the sodium amalgam in the mercury itself or by some simple means of mechanical agitation.

As a very small percentage of sodium forms with mercury a solid amalgam in which the mercury ceases to diffuse and can not be easily mechanically removed, one of the difficulties connected with the two-compartment system where mercury is used arises from the fact that it is not possible to do a large amount of work in each separate cell, and hence a very large plant is required to decompose a comparatively small quantity of brine, and this large size of the plant of course increases the capital required for the production of a given quantity of chlorine and caustic.

The Rhodin cell was designed to obviate these difficulties. The cell itself is very simple. It consists of an outside shallow dish or containing vessel made of cast or wrought-iron, as seen at DD in the accompanying drawing. This drawing is diagrammatic and not intended to exhibit the method by which the brine and caustic solution is run into the vessel and drawn out of it, as exhibiting the necessary pipes for this purpose would only complicate the drawing. Inside this iron vessel DD there is another vessel made of earthenware, which consists of an inverted portion, from the bottom of which a series of open tubes project, the edges of which pass down beneath a layer of mercury M, which is placed in the bottom of the iron vessel DD. In the top of this earthenware vessel there is a cylindrical opening or tube O, which has at the top a water seal S. This cylindrical pipe is made to revolve on its axis, so that the whole of the inverted vessel is carried round the central axis of this pipe, which is kept in its place by a bridge E spanning the upper portion of the containing vessel DD. The revolution of this vessel is accomplished by means of a wheel W which works into a worm, and which is driven by a belt K from any suitable source of power. The top of this cylindrical vessel is divided into six or more compartments, each of which is perforated by a number of holes through which carbon cylinders CC are inserted.



CROSS-SECTION OF RHODIN ELECTROLYTIC CELL FOR MAKING CAUSTIC SODA AND CHLORINE.

In large-sized cells these triangular compartments may be made separate and enclosed in an iron frame. The carbons are held together by a layer of cement which fills the top of the triangular compartments level with the projecting rim at A. Immediately beneath the collar of the girder E, which carries the tube O, there is a ring of metal F, which is carried round when the vessel revolves. All the carbons are connected up to this ring F by suitable metallic leads which are in electrical connection with the carbon cylinders. A brush B slides on the ring F and connects the carbons with the positive side of the source of current. The negative side is connected to the vessel D.

The layer of mercury M forms a sealed joint with the lower edges of the inner earthenware vessel A, so that when this vessel is filled with brine R, and the outer annular space NN is filled with pure water, no connection between the liquid contents of these two portions of the cell can possibly take place.

When electric current is sent through the cell the current passes from the lower end of the carbon cylinders to the surface of mercury M. The chlorine is given off at the surface of the carbon poles, and is carried away through the center tube O and the hood G to the bleaching powder chambers. The sodium amalgam forms on the surface of the mercury in the inner portion of the vessel at the bottom surface of the brine and passes, partly by diffusion and partly by the mechanical agitation of the mercury, occasioned by the revolution of the inner vessel, to the outer annular space NN, where the layer of water VV extracts the sodium in the form of caustic soda.

The mechanical agitation is assisted by placing radiating vanes in the bottom of the containing vessel, which are represented in the diagram at H, and these conduct the mercury to the outer edge of the vessel.

In actual working, the iron-containing vessel DD is heated externally to such a temperature that the liquid contents of the cell are raised to a little short of boiling point, and this not only prevents the absorption of a large amount of chlorine in the brine, but also very much increases the efficiency of the water in taking out the caustic from the amalgam and reducing the electrical resistance of the liquid film between the lower surface of the carbon cylinders and the surface of mercury.

The American Alkali Company, which will operate the above described process in the United States, has been formed by W. W. Gibbs, of Philadelphia, and A. R. Harvey, of London. Other prominent men interested in the company are Martin Moloney, Thomas Dolan, P. A. B. Widener and W. L. Elkins, all of Philadelphia. Mr. Gibbs is well known as a financier and promoter of such profitable enterprises as the United Gas Improvement Company, the Welsbach Light Company, the Electric Storage Battery Company and the Electric Vehicle Company.

SCIENCE BREVITIES.

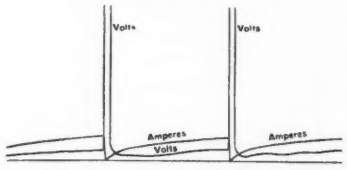
Dielectric Strength—Mr. T. Gray describes in the *Physical Review* experiments made upon the dielectric strength of a large number of substances. The pressure used was measured by a Kelvin voltmeter on the primary of a transformer, working up to 100,000 volts in the secondary. The table below gives a summary of his results:

Material.	Maximum Dielectric Strength in Kilovolts per Centimeter.
Glass	285
Hard rubber	588
Soft rubber	476
Soft rubber, second quality	492
Mica	2,000
Micanite	4,000
Papers paraffined:	
Manila wrapping	430
American linen	540
Blotting felt	150
Fuller braid	295
Empire cloth	310
Empire paper	450
Lubricating oil	48
Linseed oil	83
Cotton-seed oil	67
Air, 0.02 centimeters between plates	57
Air, 1.6 centimeters between plates	27

Accumulators for Automobiles in Paris—The remarkable results attained during the recent trials of accumulator vehicles in Paris have attracted much attention. M. Hospitalier, in an article communicated to the Société Internationale des Electriciens, gives the details of the Fulmen cells used by all the cabs. Each contains six positive plates and seven negative plates, the area of the positive plate being 321 square inches. The total weight of the accumulator, with its electrolyte, is 16½ pounds, and its normal discharge is 21 amperes at 1.9 volts for five hours.

Uranium Rays—In *Comptes Rendus*, M. Henri Becquerel gives an account of a repetition of some of his early experiments upon the rays bearing his name, and concludes that his original deductions were at fault to a large extent. It can not be proved, according to the later researches, that these rays, whether proceeding from uranium, thorium, radium or any other substance, can be made to suffer either polarization, reflection or refraction. There are some indications of diffused reflection, and this, with the absence of the properties noted above, puts the rays in a position closely similar to that of the X-rays. The author considers that the source of the energy of these rays is still an open question. The substances which emit them are active, even when kept beyond the range of any known radiation for as long as three years. It has been suggested that the radiation is kept up by some internal process, but, since no physical alteration of the materials seems to be capable of increasing the energy thus given out, this proposition is apparently untenable. There is nothing more curious in the whole range of recent scientific discovery than these rays. Certain substances seem to pour them out in utter defiance of the law of the conservation of energy. It is likely that the discovery of the true source of such radiations will be a long step toward the solution of the deeper problems of the nature of matter, the nature of the ether and the nature of gravitation.

Wehnelt Interrupter Wave Forms—In a recent communication to the Académie des Sciences, M. André Blondel gives the results of recent investigations with his oscillograph upon the form of waves due to the Wehnelt interrupter. The illustration reproduced herewith gives the form of both the current and voltage waves. The experiment was made with a rate of interruption of 40 periods per second, the self-induction



WEHNELT INTERRUPTER WAVE FORMS.

in circuit with the instrument being from 0.2 to 0.3 henry. The interrupter anode consisted of a platinum wire three-eighth-inch long and one-fiftieth-inch in diameter. The pressure at the source of supply was 33 volts, and the current five to six amperes. When the cell was in operation the pressure at its terminals increased to 75 volts, a phenomenon often noticed and referred to before. The figure clearly shows the sharp interruption of the current wave when it is increased to a certain point, and the instantaneous and enormous increase in voltage. The volt curve went off the scale of the instrument in all cases, and its absolute maximum could not be determined.

A Magnetic Island—The island of Bornhohn, in the Baltic Sea, is said to consist of a mass of magnetic iron ore, and its magnetic influence is not only very well known to the navigators of those waters, but also much feared by them. This is on account of its influence on the magnetic needle, which makes the proper steering of a ship in its neighborhood a matter of much difficulty. In fact, this influence is said to be felt even at a distance of miles, and so palpably that, on the island being sighted by mariners on the Baltic, they at once discontinue steering their course by compass and turn instead to the lighthouses to direct their craft. Between Bornhohn and the mainland there is also a bank of rock under water, which is very dangerous to navigation, and, because of it being constantly submerged, vessels have been frequently wrecked at that point. It is said that the magnetic influence of this ore bank is so powerful that a balanced magnetic needle suspended freely in a boat over the bank will take a vertical position.

Zinc Accumulators—M. Georges Pellissier, writing in *L'Eclairage Electrique*, describes accumulators having lead positives and zinc-coated copper negatives. These cells are said to give a mean electro-motive force of 2.3 volts and a maximum of 2.5 volts. A battery, weighing 752 pounds, inclusive of everything, has a specific energy of 16.5 watt-hours per pound for a 10-hour discharge, or 13.3 watt-hours per pound for a four-hour discharge. The best figures given by any European or American maker of accumulators hitherto has been five watt-hours per pound of the complete cell, including the ebonite box and the acid.

Indian Mica Mining—Mr. Amervyn Smith recently read a paper before the British Institution of Mining and Metallurgy on the above subject. He has recently visited the principal mica districts in India, and describes in his paper the form in which payable mica is found. It seems that it is only within recent years that Europeans have taken up the mica industry, and that the mining as carried on by the natives is both wasteful and expensive. There are four kinds of mica recognized by the Indian dealers, the qualifications being as follows: Hard and tough ruby mica; white transparent mica; the third division is discolored and smoky mica, while the last class is called black mica, and in it are included the mica flakes obtained in trimming the other varieties. Mr. Smith estimates the total output per annum at about 17,000 hundredweight, of which about half is exported. The growth of the export trade is clear from the following figures: In 1892 only 2,298 hundredweight of mica was exported from Bengal, whereas in 1896 the amount had risen to 8,835 hundredweight. The author concludes that the supply of mica in India is practically inexhaustible, and that some of the veins are extremely rich. The present method of mining is, however, very wasteful, as practically nine-tenths of the mineral extracted is injured and rendered useless for export. This waste mica could, however, be used very largely in the manufacture of micanite, and the manufacture of this commodity should prove a remunerative adjunct to any company taking up mica mining on a large scale in India.

Suit on Tesla Patents.

In the United States Circuit Court at Philadelphia, on April 24, Judge McPherson heard argument in the equity suit of the Tesla Electric Company, of New York, against Gordon J. Scott and others, of Philadelphia, in which it is sought to have the defendants enjoined from the making of alleged infringements on the plaintiff's patented improvements in electro-magnetic motors.

Notes on Light—A Correction.

TO THE EDITOR OF ELECTRICAL REVIEW:

Through carelessness at my office the cut which was printed with Note LX was the wrong one and shows no vacuum regulator. I, therefore, have written this supplement to give a place to the proper cut, which has a tube on the anode stem serving as its support and a means of attachment to one terminal from the generator.

W. ROLLINS.

Boston, April 28.

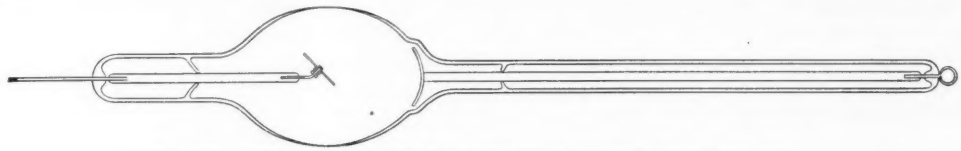


FIG. 56.—"NOTES ON LIGHT"—ROENTGEN TUBE WITH VACUUM REGULATOR.

Mr. Frederic Nicholls, of Toronto, ex-president of the National Electric Light Association, was in New York city last week.

A New Liquid Interrupter.

To the Editor of Electrical Review:

The interest that has been taken in the ingenious method of Dr. Wehnelt for interrupting the current of induction coils has led me to take up again some experiments of this kind which I made some time ago in connection with telephonic work.

The instrument, which I shall describe (when used as an interrupter for an induction coil) produces almost exactly the same effects as are obtained by the ingenious device of Dr. Wehnelt, and I think it is, perhaps, free from some of the uncertainty of action of that instrument.

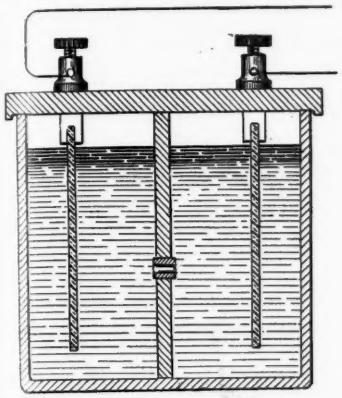


Fig. 1.—Caldwell Liquid Interrupter.

The typical form of the instrument is shown in Fig. 1, which is taken from the patent drawing. A receptacle made of an insulating material, and divided into two compartments by an insulating partition, through which a small aperture is left, is filled with a conducting liquid. Suitable electrodes are immersed in the liquid on either side of the partition, so that, when current is sent through the apparatus from one electrode to another, it must pass through the liquid which fills the aperture of the insulating partition. If this aperture be very small and the current relatively large, the heat developed at this point will form a bubble of steam which will break the circuit. As soon as the circuit is broken the source of the heat is removed, the bubble escapes, the two portions of liquid come again into contact and complete the circuit. This is repeated over and over again with astonishing rapidity, and if the interrupter be connected in series with the primary circuit of the induction coil, beautiful streams of sparks, resembling those obtained with high-frequency mechanical interrupters, play across the secondary terminals.

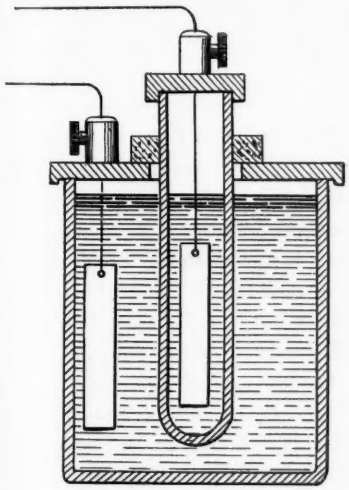


Fig. 2.—Caldwell Liquid Interrupter.

It is probable that electrolytic action in this instrument is not at all essential to its operation, and that its action is entirely thermal.

So far I have tried only a few solutions for the liquid—dilute solution of sulphate of copper, a solution of sodium sulphite and a sulphuric acid solution of specific gravity of about 1.200.

Of these the sulphuric acid gave by far the best results.

The instrument has also been operated by using mercury for the liquid conductor, but in the few experiments I have made the results obtained by the mercury were unsatisfactory, and the partition between the two parts of the liquid (which in this experiment was made of glass) was cracked and apparently burned in a very few minutes.

The frequency of interruption seems to depend upon the current strength, the diameter and length of the orifice, the inductance in the circuit and, to some extent, upon the temperature of the liquid and probably upon the capillary action between the liquid and the material forming the insulating partition. By varying the diameter of the orifice I have been able to obtain interruptions varying in frequency from about five per second to probably 400 or 500 per second.

I have noticed that when a large inductance is in the circuit the action seems to be much steadier. When there is no appreciable inductance in the circuit the interruption takes place, but irregularly. A rule that has been observed that when there is little or no inductance in the circuit there is little or no spark formed by the break, but with a large induction coil in the circuit the orifice in the partition appears to be filled with fire. Notwithstanding this fact, however, the break seems to be very sudden and sharp. The discharge from the secondary seems to be unidirectional, and is very well adapted for exciting X-ray tubes.

Two of the figures show photographs of the spark, made when the interrupter was working with a frequency judged to be about 180 to 200 per second. These sparks were about eight inches long.

Fig. 3.—"Liquid Interrupter"—Secondary Discharge—Exposure, One Minute.

A convenient form of the instrument is shown in Fig. 2, where the insulating partition is formed by an ordinary test tube having a small hole in its side. With a coil in which about six or seven amperes are used in the primary, and an orifice through the test tube about one millimeter in diameter, this arrangement gives a frequency from about 150 to 180 per second.

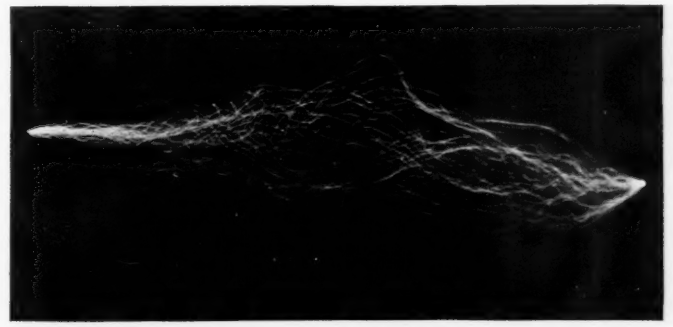


Fig. 4.—"Liquid Interrupter"—Secondary Discharge—Exposure, One-Quarter Second.

I have not as yet had an opportunity to make a careful experimental study of this apparatus, and I have no doubt that further work will develop many improvements in the practical details.

E. W. Caldwell.

New York, April 29.

Association of Railway Telegraph Superintendents.

This association will hold it next convention at Wilmington, Del., on May 17. Headquarters will be at the Orton House. The Seaboard Air-Line has arranged to transport delegates and their families by special movement to Wilmington from Norfolk, where all are expected to meet on May 15.

The Marconi System.

To the Editor of Electrical Review:

I am glad to see you take the position you do in the Review of April 26, in reference to Marconi's telegraph. "Possibilities" are not "probabilities." Our wireless telegraph enthusiasts will find plenty of hills to climb and obstacles to overcome before their dream is accomplished. The telephone has been through just such vagaries. We were on the eve of ocean telephony—no doubt of its success existed in the minds of the enthusiasts, but when land lines of any unusual length were tried obstacles met the engineer that were only overcome by applying experience and sound practice to the construction of lines for the purpose to which they were to be applied. Ocean telephony is a long way off, even yet, not because it is not theoretically practicable, but because the investment would not pay.

The X-ray is another example of the mercurial exuberance of our enthusiastic friends. We haven't heard yet of the privacy of our homes being invaded by the X-ray photographer, though such a thing is still theoretically practicable.

My remarks are not directed at theory, but at the cranks throughout the country—the "would-be" electricians in every little community who exaggerate their own importance by discussing so learnedly a science, the fundamental principles of which they have yet, themselves, to master.

That wireless telegraphy has a field of usefulness very few of us doubt, but the difficulties in the way of its successful operation when more than two instruments are within each other's vicinity will limit its usefulness, unless some means of "selection" can be devised. For use in life-saving stations and on ships, it undoubtedly will become of great value.

Allow me to congratulate the Review on its continually improving usefulness and believe me,

Sincerely yours, H.

Electrical Review

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News, Subscriptions and Advertisements.

SPECIAL NOTICE TO ADVERTISERS.

CHANGES for advertisements must be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Saturday noon to insure publication the following week, although it is occasionally possible to get in matter received on Monday.

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A school for instruction in wireless telegraphy is to be established in London. The Board of Trade, it is said, is interested in the project.

It appears that automobiles are "articles or wares composed wholly or in part of metal," for the Secretary of the Treasury has just made a ruling that such machines belong in this category and must pay an import duty of 45 per cent ad valorem. Many more automobiles are leaving the country than entering it, however, as the American machine has already earned considerable popularity abroad.

Electric boating is not as popular in this country as it deserves to be. In England, as well as in France, the electric boat has become almost a common sight on the streams frequented by pleasure craft. We are only just beginning here to appreciate the fact that electricity is incontestably the best power for a pleasure boat. Indeed, it is quite likely that there will be an increasing use of electric power for other craft. For short and frequent ferry service, for instance, electricity is demonstrably superior to steam in economy.

The gas companies in New York city (Borough of Manhattan) have just announced a reduction in the price of gas from $1.10 to 65 cents per 1,000 cubic feet.

This is the result of the growing popularity and increasing economy of electric lighting. The electric light companies have been giving an admirable service at exceptionally reasonable rates, and this has practically forced down the price of gas. As an illuminant its use is rapidly growing less, despite the momentary vogue of Welsbach burners some time ago. To-day gas is being used very largely for fuel, a purpose for which it is admirably adapted.

The annual report of the General Electric Company, which appears in full elsewhere in this issue, makes a gratifying showing, and more than confirms our forecast of the report which appeared in the ELECTRICAL REVIEW for March 8. The stockholders of the company are to be congratulated on the excellent position in which they at present find themselves. The impairment of the capital stock has been corrected, and the patent account has been reduced from $8,000,000 to $4,000,000. The accrued dividends on the preferred stock have been paid, as well as the current dividend to January 31. Instead of the deficit of last year of over $11,000,000, the company now has a surplus of $156,570. It is expected that a dividend will be declared on the common stock at the annual meeting on May 9. The prospects for the General Electric Company were never brighter than at the present time.

CURRENT INTERRUPTERS.

The problem of making an entirely satisfactory apparatus to rapidly make and break a circuit, in which a direct current is flowing, is one that has puzzled a host of experimenters. In the early days of the induction coil Ruhmkorff tried first a simple ratchet, but this was too slow in operation. In the hands of Warren De La Rue and others the coil was finally improved to its present day form, using a vibrating spring-break and a condenser shunted around it to keep down the spark.

With the publication of Roentgen's classical paper interest in induction coils awakened at a bound. The coil was no longer an instrument of the laboratory, but became at once an important, practical machine with an enormously useful purpose to serve. Break-circuit apparatus without number were designed, many of them of surprising excellence when the difficulties surrounding such apparatus are considered. But there was no real advance in the art of current interruption until Dr. Wehnelt described the remarkable electrolytic interrupter bearing his name. This instrument is so simple and the results attained through its use so remarkable that it has attracted much attention.

To the same class, in so far as the fluid nature of the interrupting medium is concerned, belongs the interrupter described by Mr. E. W. Caldwell on another page. In its method of operation, however, it differs greatly from the Wehnelt instrument, though no entirely adequate theory for its action has yet been proposed. Electrolysis seems to play no part in it, as it works well even when mercury is used for the fluid element.

It will be interesting to watch the development of these high-frequency liquid circuit-breakers, because it is probable that the solution of the problem of vacuum-tube lighting is bound up with the production of a perfected current interrupter.

POPULAR IMAGINATION AND SCIENCE.

The daily newspaper is a reflex of the popular imagination; it mirrors the passing phases of public sentiment or appreciation, and even helps to maintain the strange fashions in scientific matters which seem to affect the public. For example, the X-ray, first quietly announced in a scientific journal, when it was presented to the public by the daily press became at once a marvel of marvels. Privacy was to be at an end, said the newspapers. People could even look through us, and the strongest walls and thickest doors would not prevent the evil-minded person from taking pictures of us, should he so desire. The craze about the X-rays died out after nearly everybody in the civilized world had looked through a fluoroscope at his or her hand, and satisfied the scientific curiosity which is a marked feature of our race. Now the X-ray craze has been replaced by chimerical popular theories about what the newspapers call wireless telegraphy. The article by Mr. Rankin Kennedy, printed on another page, punctures some tires of fallacy upon which even scientific men have been gently rolling along to wrong conclusions. The mere fact that a thing is mysterious is enough apparently to set the public agog. If anybody wants a real genuine mystery to speculate about, let him undertake to answer the simple question: Why does a stone fall when it is dropped?

NATIONAL ELECTRIC LIGHT ASSOCIATION.

PROGRAMME OF THE TWENTY-SECOND CONVENTION, NEW YORK, MAY 23 TO 25.

At the twenty-second convention of the National Electric Light Association, to be held in Madison Square Garden, New York city, May 23 to 25, inclusive, papers on the following subjects will be read and discussed:

"Single-phase Distribution," Herbert A. Wagner, St. Louis, Mo.

"Underground Electrical Construction," Louis A. Ferguson, Chicago, Ill.

"Some Notes on Underground Distribution of Two-phase Current in New York City," E. A. Leslie, New York city.

"The Development of High-Tension Service" (illustrated by stereopticon), Calvin W. Rice.

"A Local Transmission System—Development and Operation," W. S. Barstow, Brooklyn, N. Y.

"Alternating-Current Generation and Distribution—Changes Contemplated in Atlanta," H. M. Atkinson, Atlanta, Ga.

"Means of Affording Safety in Electrical Distribution," W. L. R. Emmet, Schenectady, N. Y.

"Rotary Transformers and Storage Batteries, and Their Relation to Long-Distance Transmission," Prof. W. L. Robb, Hartford, Ct.

The discussion on "transformers" will be led by Professor Goldsborough, of Purdue University, Lafayette, Ind.

Several topics of great interest to central station managers will be discussed; subjects to be announced later.

The General Electric Company has extended an invitation to the active members of the association to visit their factories at Schenectady, and they have arranged for a special train via New York Central Railroad to leave the Grand Central Station on the morning of May 26, reaching Schenectady in time to give all the afternoon for visiting the works, and arriving at the Grand Central Station again at about 10 o'clock the same evening.

The Trunk Line Association, the Central Passenger Association, the Southeastern Passenger Association and the New England Passenger Association have granted a special rate of a fare and one-third, on the certificate plan, for the round trip, from all points in their territory, for delegates and friends attending the convention. This rate is good for three days (not including Sundays) preceding and three days following the adjournment of the convention.

The Electrical Exhibition, to be held under the auspices of the association, will open at Madison Square Garden on May 8, and will continue until June 3.

This exhibition will show the development of electricity, in all its branches, at the close of the nineteenth century. Particular attention will be given to the advancement in electric lighting apparatus. One interesting exhibit will show the improvement in the arc light, showing, step by step, the advancement made from the Jablochkoff candle to the modern lamp.

Two of the special features of the exhibition will be experiments with wireless telegraphy and with liquefied air. There will also be the finest display of automobiles ever made in this country.

Passes to the exhibition will be issued to members of the association and delegates attending the convention, upon application to the secretary.

Wall Street and the Electrical Stock Market.

The stock market for the current week indicated that holders of stocks are not desirous of parting with them at prevailing prices. Confidence in a renewal of the bull movement is fairly strong. The trade of the country is still in immense volume, and there is promise of a fairly easy money market for the next three months. Changes in price for the current week were usually limited.

On the New York Stock Exchange General Electric closed at 118½ bid and 119½ asked, a gain of ½ point for the week. A prediction was made to-day that this stock would sell at 140 during the Summer on the strength of its earnings. Metropolitan Street Railway, of New York, closed at 242 bid and 242½ asked, a loss of 8½ points for the week. Third Avenue Railroad, of New York, closed at 222 bid and 225 asked, a gain of 5 points for the week.

On the Boston exchange American Bell Telephone closed at 365 bid and 367 asked, a gain of 2 points in the bid price for the week. Erie Telephone was not quoted to-day.

On the Philadelphia exchange Electric Storage Battery common closed at 186 bid and 190 asked, a gain of 5 points for the week. Union Traction closed at 43¼ bid and 43½ asked, a gain of ½ point for the week.

On the curb, or outside market, in New York Electric Vehicle closed at 132 bid and 136 asked, a loss of 5 points for the week. Electric Boat closed at 34½ bid and 35½ asked, a gain of 1½ points for the week.

Wall Street, April 29.

The Columbia Automobile Company.

The Columbia Automobile Company, of Hartford, Ct., has been organized under New Jersey laws with a capital stock of $3,000,000. The basis on which it was organized was the motor-carriage department of the Pope Manufacturing Company, manufacturers of the Columbia bicycle and an extensive line of electric vehicles which have from time to time been described in the columns of the ELECTRICAL REVIEW.

The Columbia Automobile Company has secured the exclusive license from the Electric Storage Battery Company, of Philadelphia, for the manufacture of accumulators for carriage purposes. It is understood that this branch of the business will be carried on in Hartford, and that the Electric Vehicle Company, of New York, will supply the vehicles. The motor-carriage plant of the Pope Manufacturing Company is now running 22 hours a day, and extensive new buildings are being prepared for the use of the Columbia Automobile Company.

The officers of the new company are Col. Albert A. Pope, president; Geo. H. Day, vice-president, and Harold H. Eames, secretary and treasurer. Mr. W. C. Whitney, of New York, and Mr. P. A. B. Widener, of Philadelphia, are among the directors. It is understood that subcompanies will be formed in various cities to operate, under license, the vehicles manufactured by the Columbia Automobile Company.

An Electric Vehicle Company for Chicago.

The ELECTRICAL REVIEW is informed that an electric vehicle company to operate in Chicago is now being formed. It is rumored that Mr. Samuel Insull, president of the Chicago Edison Company, is to be the president of the new vehicle company. Chicago capital and capital supplied by the Widener-Elkins syndicate will be interested in the new concern. The underwriting for the stock is to be done in New York, Philadelphia and Chicago. It is understood that this company is not the original company for which incorporation papers were recently issued at Springfield, Ill., but is a new company into which the first-named company is to be merged.

Boston Electrical Company Burned Out.

The building on Dover street, Boston, occupied partly by the Electric Gas Lighting Company, was burned out on April 30, entailing a loss estimated at $100,000.

PERSONAL.

Mr. P. C. Burns, president of the American Electric Telephone Company, of Chicago, is visiting New York city.

Mr. J. P. Ord, comptroller of the General Electric Company, has sailed for Europe, and expects to be away for about two months.

Mr. H. H. Brooks, general manager of the American Circular Loom Company, of Boston, has returned home after a visit of several months to Bermuda.

Mr. Marshal Halstead, United States consul at Birmingham, Eng., paid a visit to the ELECTRICAL REVIEW office last week and reports that great interest in American electrical matters is evident in England.

Mr. Frank W. Harrington, who has a wide acquaintance in the electrical field, has accepted a position in the rubber-covered wire department of the John A. Roebling's Sons Company. Mr. Harrington's territory will include New York state and New England, and he will make his headquarters at the New York office of the company.

Mr. Burt S. Chamberlin, secretary and treasurer of the Williams Electric Company, of Cleveland, and Miss Marion E. Coleman are to be married at the home of the bride's family in Cleveland. Mr. Chamberlin has been with the Williams Electric Company since the organization of the company, and has many friends in the telephone field who will want to offer well wishes.

President Glidden, of the Erie Telephone and Telegraph Company, has returned East after an absence of eight weeks in the territory of the company. Mr. Glidden visited Minneapolis, St. Paul, Grand Rapids, Detroit, Galveston, Houston, San Antonio, Austin, Dallas and Little Rock. He says: "The country is in a most prosperous condition. The telephone business leads in point of activity, and notwithstanding the Erie system made a net gain of 4,025 subscribers in March and was putting in over 100 daily in April, we are nearly 5 000 behind our orders on account of the delay of the manufacturers in furnishing material."

Storage Battery Patent Suit Postponed.

The suit of the Electric Storage Battery Company, of Philadelphia, vs. the Hatch Storage Battery Company, of Boston, which was set for trial before Judge Colt in the United States Circuit Court of Appeals at Boston, on April 28, has been postponed until May 3.

THE ARC LAMP DEPARTMENT OF THE CENTRAL STATION BUSINESS.

BY H. W. HILLMAN.

There is no one branch of greater importance to the central station business to-day than the arc lamp department. While many of the larger central stations have realized the need for such a department and appreciated its importance, the majority of the electric lighting companies throughout the country have not as yet given this subject the attention it deserves.

To create and maintain a successful arc lamp department, one of the most essential requirements is to secure the services of some bright, active solicitor, well posted on the subject of modern arc lamps, the cost of operating, arguments in their favor, as well as against other forms of artificial light. Often the lighting company has some energetic man, either in its office or station, who can be educated to take up this work to the advantage of the company and great assistance to the central station manager. In other cases the managers are able to devote considerable personal attention to the matter of soliciting. There are many lighting companies, however, which are suffering in this respect for the reason that the manager is not only too busy to devote much time to the arc lamp business, but has not as yet considered it sufficiently important to place a man on this particular work.

Some of the prominent subjects with which the solicitor should be familiar in order to make a good showing for the arc lamp department are as follows:

The relation of the central station to the merchant.

Adaptability of electric arcs to store illumination.

Familiarity with modern methods of illumination. Also candle-power ratings.

Importance of careful installation.

Specialties in arc lighting; low-current lamps, etc.

Thorough knowledge of arguments against Welsbach burners.

Maintenance-expense, quality of light and cleaning of inner globes.

The Relation of the Central Station to the Merchant—The solicitor is the backbone of the arc lamp business. Upon his attitude toward the merchants depends to a great extent the increase of customers on the commercial circuits.

It is of vital importance that the relation of the central station and the merchant should be very close. There is an extensive demand among the merchants for the very best light obtainable, and the solicitor who keeps posted with this demand, studying carefully the needs of the merchants in every way, is of invaluable assistance to the station manager. Such practice is conducive to a prosperous business, and the use of light in great abundance.

Where central stations have not, as yet, introduced the modern interior arcs among their merchants, it is the duty of the solicitor to study the situation carefully. Do not "beat around the bush" and attempt to temporarily discredit new lamps which some energetic merchant of your town has seen when visiting New York city. Urge your superintendent or manager to favor the most important customers you have, introducing the new arcs gradually, and after careful consideration. The electric lighting company should lead and the merchant follow in the adoption of a first-class light. Create the pleasantest relations with your merchants, and maintain them strictly. By so doing, your commercial circuits will always afford you handsome returns.

Adaptability of Electric Arcs for Store Illumination—Artificial light was never known to have been used so freely in the commercial world as at the present time, and the adoption of arc lamps for interior illumination has encouraged this new lighting era. There never was a period in the history of the electrical industry when the central station was enabled to furnish to the merchants so suitable and attractive a lamp; a light pleasing to the eye, perfectly suited to the display of all classes of material; quick to illuminate and easy to extinguish; its design chosen with care, that its size and appearance might harmonize with the surroundings common to the modern department store. Evidence is not lacking to demonstrate the perfect satisfaction which this form of light has met with among merchants. The rapidity with which central stations have introduced the lamps is indicative that the light is pleasing, and the business mutually satisfactory. In a city of medium size, in New York state, 400 alternating enclosed arcs were installed during a period of from six to eight months. A central station in Ohio introduced some 300 direct-current enclosed lamps in the short space of 90 days. A large plant in the South has placed on its circuits in excess of 1,000 alternating lamps since the Spring of '98, while an aggressive station in the state of Michigan, operating in a city of only about 25,000, has between 200 and 300 lamps in use among its merchants. The close relationship between the central station and the merchant, as well as the perfect adaptability of the interior arcs for store lighting, partially account for such remarkable results as referred to above.

Familiarity with Modern Methods of Illumination, also Candle-Power Ratings—As there are a great many classes, styles and finishes which go to make up the full line of lamps for alternating and direct-current circuits, it becomes somewhat of a study to know what to recommend, when submitting proposition for lighting a department store. In the old days, when the ordinary series arcs were used, the amount of light produced depended upon the current of the machine. In one town, 6.6 ampere arcs furnished the stores with a certain volume of light, while the adjoining city stores were favored with 10-ampere lamps of greater illuminating capacity. The size, dimensions and adornment of the lamps were likewise unsuited to the commercial needs. To-day, however, the solicitor is favored with the most artistic shapes and fancy designs. Great, long lamps have been replaced by those of short and attractive size. It is the pleasure of the merchant to highly commend the lamp design as well as the character of the light.

Opportunities are afforded for skillful arrangement in the matter of installation. Fig. 1, the single globe style of lamp, is most popular for many classes of business, whereas the double-globe type can be highly recommended for certain work—especially in the display of materials exhibited among the various departments in dry-good stores. Merchants will highly appreciate the extra time spent by the solicitor in studying his requirements for light, and the earnest efforts put forth to furnish the most modern and up-to-date lamps known to the trade. Let the lighting companies all over the country advertise these points, for they are strong arguments. The lighting industry of the world has been revolutionized, and the arc-lamp department has now become one of the most prosperous branches of the central station business.

Merchants frequently ask, "What is the candle-power of your lamp?" and are greatly confused upon being advised that it is 1,200 or 2,000 candle; in fact, the solicitor and station manager likewise meet with considerable difficulty when touching upon this subject. Reference to a 1,200 or 2,000 candle-power rating means but very little to a merchant. A much easier, clearer and more satisfactory method is to refer to the number of square feet of surface which can be satisfactorily lighted by each arc lamp. As an illustration, a room containing 2,800 square feet may be very well lighted by four alternating, six-ampere lamps, each lamp lighting an area of 700 square feet. The lamps are suspended eight feet from the floor.

This method has been practiced by many solicitors to advantage. As to the meaning of the term "satisfactory illumination," it has been stated that what might be considered satisfaction by one merchant would not be acceptable to another. This point can easily be settled by selecting a representative store and installing lamps according to this method of rating. The solicitor can then refer to this installation, and induce prospective customers to investigate the satisfaction as experienced by the proprietors themselves.

This rating, of course, would not apply where material such as draperies and curtains are supported from the ceiling, tending to obstruct the light, and detract from its best distribution. In such places a lamp of less illuminating capacity should be installed and a greater number of lamps furnished. A solicitor well posted on the subject of light distribution and best methods of illumination will command the respect of the store proprietor, greatly increase the efficiency of the arc-lamp branch of the lighting company and reduce to a minimum the number of complaints due to poor artificial lighting.

Importance of Careful Installation—The good results accruing from the exercise of special care in the installation of lamps fully warrant giving special attention to this point. In this connection a wide-awake solicitor will interest himself in the matter when the installation is being made, by inspecting the lamps thoroughly before being satisfied that they are right. His duty is not ended simply because he has seeured a new customer, for, if the lamps give trouble, then the merchant expects the solicitor to see that they are made satisfactory. A close coöperation between the solicitor and the arc-lamp-testing man at the station will produce excellent results and obviate trouble before it exists.

Infrequently it happens that trouble commences when the lamps are being placed on the circuits. One case is cited where lamps were recently installed in a large clothing store without a switch to throw the lights on and off, either collectively or individually. It was arranged that they should be lighted by using a long stick to strike the switch attached to the top of each lamp. As distinct from this method the cut below—Fig. 2—shows a modern arrangement in the form of an incandescent lamp cord suspended from the arc lamp attached to which is a push-buttot switch. This furnishes a most convenient arrangement, and is, at the same time, inexpensive to install. Another point essential to satisfactory service is to inspect the frequency and voltage connections before installing. The frequency of the circuit is, of course, known, but the lamp may be connected wrong when received from the manufacturer, and by testing at the station the matter is given attention and trouble remedied at your own door. It is much more business-like to ascertain and know the line voltage at the point of installation, carefully adjusting each lamp before installing for the proper length of arc. While these points may seem so simple as not to require mention, yet it is certainly a common thing among the stores to see lamps operating at too high or too low an arc voltage, necessitating adjustment and altering at your customer's place of business. To obviate these troubles establish a testing rack at your station; have it understood that some one man is responsible for the lamps sent out, and that each lamp is thoroughly tested before installation.

Specialties in Arc Lighting, Low-Current Lamps, Etc.—Opportunities are afforded for meeting competition against other forms of lighting by the

use of lamps of low-energy consumption. For example, a four-ampere alternating enclosed arc, consuming but 300 watts at its terminals, is attractive to the merchant by reason of its low cost of operating. By using the single-globe type of lamp, the volume of light is of a very respectable amount, and offers a first-class illuminant at small expense to the customer. The same holds true of the three and one-fourth-ampere lamp for direct-current circuits, consuming about 360 watts on a 110-volt line. Here is another instance where it is of importance that the solicitor should study the matter of installation, and exercise good judgment as to when and where to use a low or high-current lamp. The manager of the station is generally too busy to go into details, and must rely entirely upon the efforts of the solicitor to please a customer. The writer is familiar with a case not long ago, where three-ampere lamps were installed alongside of, and to replace, lamps of much higher current. The trial was a failure, and the station manager received the idea that he could not use the low-current lamp. Such cases are not uncommon. The merchant feels that the high-current lamps are costing too much money, the low-current arcs do not give a sufficient volume of light, and, finally, it results in throwing out electricity for gas, or else a compromise in the price of current. There are 750 three-ampere lamps used for interior lighting in the city of Hartford, Ct., with satisfaction to the merchants, as well as the central-station management. A solicitor can secure or lose business in proportion to the amount of study and time devoted to modern methods of interior lighting.

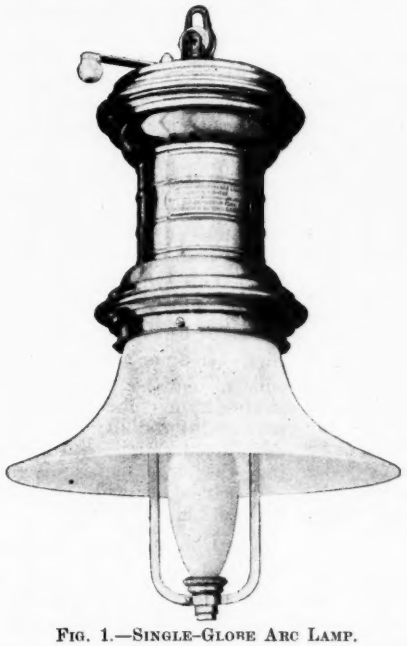


FIG. 1.—SINGLE-GLOBE ARC LAMP.

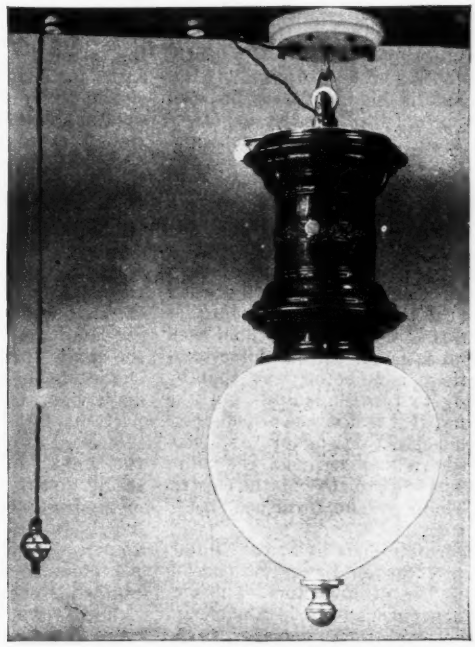


FIG. 2.—PUSH-BUTTON SWITCH FOR ARC LAMP.

Arguments against Welsbach Burners—Where competition is keen, the price of gas low, and a good solicitor employed by the gas company, it requires energetic work and effective arguments to increase the number of arcs in service or even to hold business already secured. One very good way of creating a stir in the matter of lighting is to equip the windows of some representative store with a first-class arrangement of lighting, installing the arc lamp so that the source of light is not shown, but that the material on exhibit is displayed to perfection (Cut No. 3). Then select some window lighted by Welsbachs, for comparison (Cut No. 4). The argument seems conclusive that a merchant having considered it sufficiently important to light his windows for evening advertisement can well afford to have the best light obtainable.

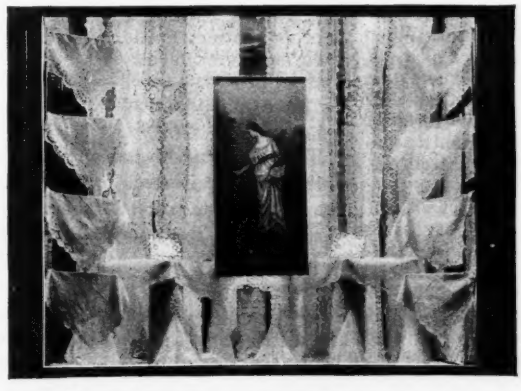


FIG. 3.—SHOW-WINDOW DISPLAY WITH CONCEALED ARC LAMPS.

These photographs were taken by the artificial light from the lamps at nine o'clock in the evening, each having had the same time exposure. By introducing lamps in the front of the store the light is called so forcibly to the attention of the store proprietor that infrequently it is an entering wedge toward displacing gas throughout the entire store; especially is this true where colors have been accurately matched beneath the rays of the electric arc. There are many arguments against the use of Welsbachs for commercial work, which are within easy access of solicitors earnestly anxious to learn all their weak points. One of the most annoying and dangerous, as well as expensive, features seems to be that of "burning off the wax" from the new mantles. Coupled with the use of matches for igniting the gas, and compared with the enclosed arc, so conveniently lighted, there would appear to be no reason why Welsbachs should be used for commercial lighting.

Maintenance Expense, Quality of Light and Cleaning of Inner Globes—There is no one thing which is of greater benefit to central-station lighting business than the maintenance of a high grade and character of light. It is this superiority which first attracted business men to the modern arc lamp, and the maintenance of its high quality of light will cause a continued satisfaction among the mercantile trade. All forms of artificial light which have heretofore developed a commercial success have required maintaining at more or less expense and annoyance. When in the old days oil lamps were common among the business houses, lamp chimneys were generally cleaned by the "boy" in connection with other duties, such as cleaning of windows, sweeping the store, etc. Welsbach mantles are either renewed by the gas company's employé, at the expense of the merchant, or some employé of the store is given this duty. As a result, neither the chimneys nor the mantles are cleaned regularly; in fact, negligence and lack of care in connection with renewal of Welsbach mantles is so well known that it has effected great injury to the gas business. The uniform character of light, the poor distribution, and the dissatisfaction on account of inattention to mantle renewals, are all contributing to the gradual displacement of gas for mercantile lighting.

The central station has a remarkable strong argument, therefore, in respect to the care and attendance of arc lamps. The merchant is required to give no attention whatever to the matter of light. He is assured that its quality can not deteriorate, for the station attendant visits each store frequently and regularly, for the purpose of either changing globes or renewing carbons. The care exercised in this matter, insures a uniform light continually.

While the foregoing deals particularly with suggestions to solicitors, there are many subjects relating to the arc lamp department which demand the personal attention of the central-station management. It is safe to assume that these subjects have not had the attention of all station managers, and as arc lamps were never more popular than at the present moment, it seems a fitting time to consider thoroughly this important subject.

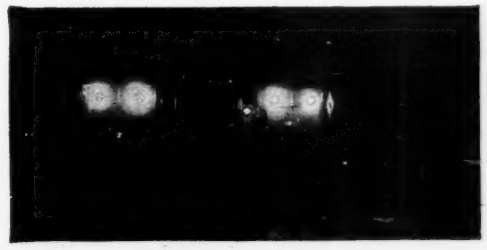


FIG. 4.—COMPARISON WITH FIG. 3, OF WINDOW LIGHTED WITH WELSBACH LIGHTS.

A Profitable yet Popular Rate of Charge Should be Encouraged—Wherever central stations have been most successful in introducing interior arc lamps, the most careful consideration has been given to the cost of operating, the selling price for current and the profits under various conditions of operation. Not only is a central station bound to furnish an appropriate illuminant, but the price

for current must be within the reach of the smaller merchants, as well as encouraging the extensive use of light among the largest customers on the service. It is surprising how easy the clerks in a store acquire the habit of throwing on the lights at any hour of the day in order to more effectually illuminate their counters. Where the price of current is high the clerks are severely criticised for the liberal use of light, and are given to understand that the greatest economy must be exercised. On the contrary, a reasonably low rate for all customers, and special rates for large and long-hour customers, educate them to use light more liberally; and as good light tends to increase sales the clerks favor its use.

Where rates are high, the inevitable result follows; namely, the loss of business and the introduction of Welsbach burners. To regain this trade and conduct an energetic campaign against gas, consider the subject of rates carefully. It will be found that while even a slight reduction in rates will decrease the profits, figuring on the same amount of business, yet the amount of business increases rapidly when dealing with arc lamps consuming nearly a half kilowatt per lamp. It may be interesting to note that 100 direct current lamps, operating an average of only four hours daily, afford a gross annual income of $7,920 at a rate of 12 cents per kilowatt hour. Considerable experience and investigation on this point of increased business shows that about 200 commercial arcs can be introduced in cities as large as 20,000 to 30,000 population, favored with two or possibly three dry goods stores. In other words, a business is created of approximately $16,000 annually, offering satisfaction to merchants and driving out of commercial use from 800 to 1,000 Welsbach burners. I have not attempted to couple with this proposition the benefits to the incandescent, power and motor branches of your business, which, if figured out on the same business, would demonstrate that while the same percentage of profit can not be reasonably expected after reducing rates, yet a lower percentage figured on an increased gross amount will produce equal, if not increased, profits in dollars and cents.

Should Central Stations Purchase Lamps and Furnish Them Free to Merchants?—As a business proposition there seems to be excellent reason why the central station should furnish lamps free. On the basis of 100 lamps, an investment would be required of approximately $2,000. At six and 10 per cent, respectively, the annual interest and depreciation account would amount to $320. The gross annual income from 100 lamps, operating a daily average of four hours, would be $7,920, figuring at a rate of 12 cents per kilowatt hour. At a fair percentage of profit the net income is sufficient to more than warrant the small investment referred to. Aside from a financial standpoint, there are many objections to the merchants purchasing the lamps. Circuits are apt to be filled with various forms of lamps, different makes and sizes of carbons and globes must be carried in stock. Central stations must keep on hand repair parts for various makes of lamps. A trimmer can not be expected to have detailed knowledge of all types of lamps and sufficient care and attention are lacking. Responsibility is also divided in the matter of satisfactory operation. Only recently the point was brought up forcibly. A merchant having purchased his own lamps complained to the manufacturer that the lamps were not satisfactory. The manufacturer advised that the station people did not trim the lamps properly. The outcome was considerable trouble, and the station adopted the policy thereafter of purchasing and owning the lamps.

Summarizing, if a central station is not in position to handle interior arc lighting and desires to hold back as much as possible from doing business, there is no better way than by refusing to furnish lamps. On the contrary, if it is desirous of conducting an active, satisfactory and economical arc-lamp business, the lamps should be the property of the electric light company and furnished free to merchants.

Modern Methods of Street Illumination, Ideas on Lamp Suspension and the Use of Reflectors—The arc-lamp department is an invaluable aid to the central-station manager, as the time draws near for the renewal of the lighting contract between the town or city and the electric lighting company. While conducting the business of interior arc lighting, the employés interested can be continually investigating the lamps of this class, designed for outdoor service. It is well to order a sample of weatherproof lamp, giving it a trial in front of your office, or, as an aggressive manager recently stated, he had the lamp installed in front of his residence, thereby to better watch its operation from night to night. When installing the lamp do not place it under a hood, or upon the old-style lamp pole, but hang it from some attractive bracket, or other form of suspension, giving particular attention to the height of the lamp from the ground. A distance of about 18 feet, measuring from the center of the inner globe, will give a very satisfactory distribution. If it is an alternating lamp, equip it with a metal reflector over the outer globe, in order not to waste the light which should otherwise be thrown upward above the horizontal line from the arc. A reflector properly designed will not unduly concentrate the light beneath the lamp, but will evenly distribute the rays over a wide range of area.

As to the best combination of globes, a clear inner and clear outer produces a very good lighting effect, but an opal inner instead of a clear is highly recommended. With this combination the volume of light does not seem to be cut off sufficiently to be noticed, even by a keen observer, yet it does away entirely with the violet color of the arc, furnishing a beautiful illumination, free from shadows and desirable in all respects.

No hood is required with this modern street lamp, and this feature, above all others, contributes to its attractive appearance. With the several thousands of lamps now installed in various parts of the country, the most favorable comments are freely made in regard to the attractive appearance of the entire installation.

The policy outlined above, if pursued in a careful manner by a central-station manager, will tend to get away from further reference in future contracts to the candle-power rating of an arc lamp. As an illustration, I would cite an actual case where a contract was recently made between a city and an electric lighting company in the West. The seven and one-half-ampere alternating enclosed arc lamp was suspended at a point in the main business street of the city and located between two old style 9.6-ampere series open arc lamps. Opportunity was afforded all parties interested to make comparison of the light distribution, with the result that the contract subsequently entered into called for lamps designated as the seven and one-half-ampere alternating enclosed arc lamp. No reference whatever was made to candle-power rating.

While the tendency among the cities and towns is gradually in the direction of securing a lower price per lamp per year when renewing the street lighting contract, yet the remarkable increase in the last few years in the amount of light used for interior lighting should encourage a liberal extension in the number of lamps required for street service. To educate the city fathers along these lines, and to consummate a plan substantially on this basis, will preserve the electric lighting business and offer bright prospects for central stations, approaching the time when another contract must be made with their city government.

CHICAGO ELECTRICAL TRADE NOTES.

The Western Electric Company, Chicago, carry in stock a full line of Stanley transformers. They have just issued to the trade Bulletin No. 101, descriptive of this type of transformers.

The Electric Appliance Company are distributing their fan-motor catalogue for 1899. It contains a complete list of desk and ceiling fans for direct and alternating and is an attractive and pleasing pamphlet. A copy will be sent on application.

H. A. Paquette & Company, 53 Dearborn street, Chicago, are manufacturers of a new interlocking whistle and elbow speaking tube which may be found on sale at electrical supply houses and hardware dealers. They have issued a descriptive circular which they will mail on application. Incidentally they state that wherever their tubes are in use they are giving the best service.

The Allen soldering stick, made by L. B. Allen & Company, Chicago, has been selling rapidly this year, and especially at this season, when construction work is progressing. This article is useful, easily handled, and is a substitute for acid and soldering salts. Its action is non-corrosive, and it is used in every branch of electrical work. The manufacturers state their sales are constantly on the increase.

Aaron Electric Company, Clinton street, Chicago, are agents for the generators and motors manufactured by the Eagle Electric Works, Peoria, Ill. This company are makers of high-grade motors, either direct connected or belt driven, and they claim their machines are among the most efficient on the market to-day. It has been their aim to combine compactness, durability and simplicity, and special care is used in constructing the machines. A price list and catalogue will be mailed on application.

The Illinois Electric Company, 239 Madison street, Chicago, are Chicago agents for the Lundell fan motor. Last year the sales of Lundell motor fans were exceedingly large, but this year promises to eclipse all others. The reputation this fan has made among the trade has been the result of many sales. The fan motor makes business good for the supply dealer at a season of the year when trade is dull in other lines. Their latest catalogue shows a number of styles and attractive prices.

The Central Electric Company, Fifth avenue, Chicago, carry in stock the Truitt regulating lamps and are selling them in many places. One revolution of the lamp, simply turning it in the socket, will produce 1, 8, 16, 24-candle-power illumination, as desired. This will be found economical and even a great saving in some cases. The Central Electric Company say that the price of the lamp is another great factor in its sale and would be pleased to quote this and all other particulars to those interested.

Chicago Enclosed Arc Lamp Company, West Jackson Boulevard, Chicago, are now in shape to take care of their orders, having just moved into their new quarters. The lamp made by this company is worthy of note, and will certainly find a leading place among the other makes in the market. The company have booked a number of orders, and from now on these will be promptly filled and shipped to their customers. The product is the result of careful work on the part of the manufacturer, and it has met with many sales. F. E. C.

NEW YORK ELECTRICAL EXHIBITION NEWS.

ELECTRIC SWIFTNESS OF PREPARATION FOR THE COMING SHOW.

Some exceedingly rapid work has just been done in Madison Square Garden, the great building in which the New York Electrical Exposition is to be opened on May 8. On Saturday night, April 29, a circus, which had had possession of the building for some time, gave its last performance, and the building was turned over to the management of the exhibition. The preparations for the circus had involved bringing in 1,800 cartloads of earth, not to speak of a large and miscellaneous assortment of dirt, and this had to be removed with the utmost dispatch. Five hundred men were set to work shoveling and carting out the earth, and building a vast floor of 25,000 square feet in the main part of the building. Work was kept up day and night, under the glare of electric lights, the gang of excavators being closely followed by gangs of carpenters who laid the great floor and these in turn being followed by wiremen who put in the 18 main feeders under the floor. The work was begun at midnight Saturday, and at 5 P. M. on Monday the dirt was all out and the great floor laid. This floor is necessarily very strong, because many heavy weights are to be supported, among them that of the largest collection of automobile vehicles ever brought together in the United States. Wherever heavy machinery is to be installed, a special system of props is put under the floor at that point.

The exhibits will be arranged in the usual booths, each having its own floor or elevated platform about six inches high above the main floor. This required an additional 18,000 square feet of floor. Around the great amphitheater an upper platform in front of the main tier of boxes has been built out some 15 feet over the seats. Some of the boxes will be decorated and filled with seats from which visitors can watch the moving scenes on the floor below. Others will be used for lighter exhibits and special exhibits. Upon the main floor will be shown the heavy machinery and a telephone exhibit.

The decoration and lighting of the building will be very elaborate. The whole of the vast ceiling will be covered with white and gold streamers running the length of the building, and concealing the girders and beams of the roof. Suspended from this will be numerous chandeliers and clusters of incandescent lights, a total of 24,000 lights being added to the present illumination of the building for the purposes of the exposition. It will probably be one of the most magnificent specimens of electric lighting that has ever been displayed.

There will be many special features of great interest, among them a loan exhibit by the United States Government, and under the direction of Mr. Ira W. Henry. The Signal Corps of the United States Army will show a number of field telegraph plants, including a flying telegraph cart which contains light wires, and is used by the advance guard of an army to keep up constant communication with the commanding general. They will show also a telegraph wagon and truck which is used for carrying a "central office on wheels," and the light steel telegraph poles used for rapid construction. Outpost carts of an old type will be shown, and hand reels with aluminum-bronze wire, by which a single soldier on sentry or outpost picket duty can pay out the wire as he advances and keep in constant telephonic communication with the rear. Among the historical and other relics, etc., that will be exhibited, is a switchboard used at Ponce, Porto Rico. This was constructed on the spot by Lieutenant-Colonel Reber out of sugar kettles captured from the enemy's plantations. The kit of instruments used at the battle of Santiago, by which the advance intrenchments were kept in constant communication with the rest of the world, and over which was sent the message telling of the surrender of the city, will also be shown. A large number of instruments of various kinds used by the Signal Corps in all its signaling systems will be on view, and the exhibit promises to be one of great interest and importance.

The United States Navy Bureau of Equipment will show a number of interesting adjuncts, including the Ardois system of night signaling, battle-order indicators used for communicating between the bridge and the gun crews in battle, helm-angle indicators, deep-sea diving lamps and samples of various electrical materials used by the vessels of the navy. Two historical relics will doubtless be greatly admired. One is the large searchlight of the "Vizcaya."

This searchlight was captured at the battle of Santiago from the Spanish cruiser, and was put in active operation on the U. S. S. "Texas" to replace one destroyed during the battle. This searchlight was used by the Spaniards during the blockade of Santiago to illuminate the entrance to the harbor, and at the time of Hobson's adventure, disclosed the presence of the "Merrimac" to the shore batteries. The other is the searchlight of the battleship "Maine." The United States Lighthouse Board will exhibit the low-tension motor buoy system and the Henry alternating-current buoy system.

These two buoy heads show the original and present type of electric-lighted buoys used by the United States Government for illuminating Gedney Channel, at the entrance to New York Harbor. The low-tension type, which was first installed, showed the practicability of this method of lighting.

The present system, which uses the alternating current, was adopted by the government four years ago to supersede the old system, it having the special advantages of making each buoy an independent factor of itself, having a specially designed transformer in the buoy head. The current is generated at Sandy Hook at a pressure of 100 volts. In passing through the switchboard it is transformed up to 1,000 volts, running over six miles of copper armored submarine cable to the electric buoys in Gedney Channel, where it is re-transformed to 100 volts in the buoy and supplied to the lamps at that pressure.

A collection of historical models and inventions, illustrating the advance in electrical engineering, will be contributed by the Smithsonian Institution.

A complete list of exhibitors is given below:

EXHIBITORS.

American Engine Co., Bound Brook, N. J., and 97 Liberty street, city.
American Electric Novelty and Manufacturing Co., 255 Centre street, city.
American Vitrified Conduit Co., 39 Cortlandt street, city.
American Electric Vehicle Co., 1545 Michigan avenue, Chicago, Ill.
American Miniature and Decorative Lamp Co., 255 Centre street, city.
American Circular Loom Co., Chelsea, Mass.
Adams-Bagnall Electric Co., 26 Cortlandt street, city, and Cleveland, Ohio.
American Mutoscope Co., 837 Broadway, city.
American Pulley Co., Philadelphia, Pa.
Allgemeine Elektricitäts Gesellschaft, Berlin, Germany.
American Electrician Co., 26 Cortlandt street, city.
Appert Glass Co., 141 Broadway, city.
American Electric Specialty Co., 123 Liberty street, city.
D. Ahern, 263 South street, city.
American Electric Heating Corporation, Cambridgeport, Mass.
Ball & Wood Co., 120 Liberty street, city.
Buffalo Forge Co., Buffalo, N. Y.
Boston Electric Duct Co., Boston, Mass.
Bullock Electric Co., 230 Broadway, city.
Bossert Electric Construction Co., Utica, N. Y.
Bryan Marsh Co., 136 Liberty street, city.
Baker & Co., 120 Liberty street, city.
Burnet Co., 115 Maiden lane city.
Cling-Surface Manufacturing Co., 146 Virginia street, Buffalo, N. Y.
Cincinnati Shaper Co., Cincinnati, Ohio.
Crocker-Wheeler Co., 39 Cortlandt street, city.
Camp, H. B., 15 Dey street, city, and Aultman, Ohio.
Colliery Engineering Co., Scranton, Pa.
Corey, R. B., 26 Cortlandt street, city.
Columbia Incandescent Lamp Co., St. Louis, Mo.
Cutter Electrical and Manufacturing Co., 1112 Sansom street, Philadelphia, Pa.
Chicago Rheostat Co., Chicago, Ill.
Dietz, Schumaker & Boye, Cincinnati, Ohio.
Dixon, Joseph, Crucible Co., Jersey City, N. J., and 66 Reade street, city.
Dale Co., The, Thames and Greenwich streets, city.
Dickford Drill Co, Cincinnati, Ohio.
D. & W. Fuse Co., Providence, R. I.
Dey Time Register Co., 23 Dey street, city.
ELECTRICAL REVIEW, Times Building, city.
Electrical Age Publishing Co., World Building, city.
Estey & Saxe, 97 Fifth avenue, city.
Electrical Appliance Co, Jersey City, N. J.
Electrical Institute of Correspondence Instruction, 120 Liberty street, city.
Edison, Jr., Electric Light and Power Co., 27 William street, city.
Electrical World and Electrical Engineer, 120 Liberty street, city.
Electricity Newspaper Co., 136 Liberty street, city.
Forbes, W. D., & Co., Hoboken, N. J.
Fayerweather & Ladew, 159 E. Houston street, city.
Frink, I. P., 551 Pearl street, city.
Fischer Foundry and Machine Co., Pittsburgh, Pa.
Granger, Francis, 26 Cortlandt street, city.
Griffing, A. A., Iron Co., 66 Centre street, and Jersey city.
Gold Car Heating Co., Frankfort and Cliff streets, city.
General Incandescent Arc Lighting Co., Thirty-third street and First avenue, city.
Hill Electric Co., W. S., New Bedford, Mass.
Hardmuth and Co., F., Ratibor, Germany.
"Hub," The, 24-26 Murray street, city.
Harris Safety Co., St. James Building, city.
International Correspondence Schools, 14 East Seventeenth street, city.
Indiana Bicycle Co., Indianapolis, Ind.
India Rubber and Gutta-Percha Insulating Co., 15 Cortlandt street, city, and Glenwood, N. Y.
Incandescent Electric Light Manipulator Co., 116 Bedford street, Boston, Mass.
Johns Manufacturing Co., H. W., 100 William street, city.
Johns Pratt Co., Hartford, Ct.
Jones and Son, J., 64 Cortlandt street, city.
Kaufmann & Alexandre, 1133 Broadway, city.
Katzenstein & Co., L., 357 West street, city.
Keiley & Mueller, 7 W. Thirteenth street, city.
Lamble, H. V., Rockaway Beach, L. I.
Libbey Glass Co., Toledo, Ohio.
Law Co., Incand-escent, 123 Liberty street, city.
Machado & Roller, 203 Broadway, city.
Meray Engineering Co., 106 E. German street, Baltimore, Md.
Manufacturers and Inventors' Electric Co., 96-98 Fulton street, city.
National Gramophone Co., 874 Broadway, city.
National Meter Co., 118 Chambers street, city.
New York Electric Equipment Co., Thirty-third street and First avenue, city
Northern Engine Co., 39 Cortlandt street, city.
Niles Tool Works, 136 Liberty street, and Niles, Ohio.
Northern Electrical Co., Madison, Wis.
New York Telephone Co., 18 Cortlandt street, city (H. L. Webb).
National Association State Engineers, 120 Broadway, city.
National Photo Machine Co., 83 Beaver street, city.
Orient Electrical Co., Youngstown, Ohio.
Ohio Electric Specialty and Manufacturing Co., Troy, Ohio.
Prindle Pump Co., 120 Liberty street, city.
Paragon Fan Motor Co., 39 Cortlandt street, city.
Pope Manufacturing Co., motor carriage department, Hartford, Ct., and Sixtieth street and Boulevard, city.
Pittsburgh Reduction Co., Pittsburgh, Pa.
Postal Telegraph-Cable Co., 253 Broadway, city.
Rockwood Manufacturing Co., Indianapolis, Ind.
Roebling, John A., Sons Co., 117 Liberty street, city.
Risley-Bird Manufacturing Co., 94 Fifth avenue, city.
Riker Electric Motor Co., 45 York street, Brooklyn, N. Y.
Rex Fire Extinguisher Co., 154 Centre street, city.
Standard Steam Specialty Co., 83 Centre street, city.
Stirling Co., The, 95-97 Liberty street, city, and Chicago, Ill.
Safety Insulated Wire and Cable Co., 229 West Twenty-eighth street, city.
Stanley Electric Manufacturing Co., 71 Broadway, city.
Sayles, J. E., 26 Cortlandt street, city.
Union Boiler Tube Cleaner Co., Pittsburgh, Pa.
Ullrich & Co., J., Thames and Greenwich streets, city.
Van Keuren, Henry R., Brooklyn, N. Y.
Warren Medbury Co., Sandy Hill, N. Y.
Williams, J. P., 39 Cortlandt street, city.
White, S. S., Dental Manufacturing Co., 1-3 Union square, west, city, and Philadelphia, Pa.
Wagner Electric Manufacturing Co., St. Louis, Mo.
Williard & Frick Manufacturing Co., Rochester, N. Y.
Whitney Electrical Instrument Co., Penacook, N. H.
Wright Disk Meter Co., Brooklyn, N. Y.
Western Electrician, Chicago, Ill.
Western Union Telegraph Company, 195 Broadway, city.
Woods Motor Vehicle Co., Chicago, Ill.

Westinghouse Company Busy.

The Westinghouse Electric and Manufacturing Company is working day and night with two shifts of men at its East Pittsburgh, Pa., shops. The company is now employing about 4,500 men.

WIRELESS TELEGRAPHY.

BY RANKIN KENNEDY.

So-called; but it is not wireless. The long vertical wire is a leading feature in transmission of electro-magnetic force to a distance. I would venture to make a simple explanation of the action of this transmitting of force from one vertical wire to another at a distance, believing, as I do, that it can be easily and clearly explained on the ordinary, well established electrical and magnetic principles so well known to most people interested in electro-magnetic work.

It is not necessary to go back to the Hertz theories. These have not yet been established, nor can they be until some one proves that the Hertzian waves vibrate at right angles to the line of their propagation, like light waves are supposed to do. Sound waves can be reflected, refracted and detected by means analogous to those used to reflect, refract and detect light or Hertzian waves, and we know that the sound waves don't vibrate in planes at right angles to their propagation lines.

It will be time enough to drag in the Hertzian theories when ordinary accepted theories fail to account for the effects.

There are only two electrical inductive effects known to electricians—electro-static and electro-magnetic, the latter represented by lines of force forming closed circuits. Both of them can act through air, non-conductors and conductors, hence it requires no wire to connect two places from one of which we desire to act inductively on the other.

Theoretically, we should be able to induce an electric current in an instrument in New York by manipulating another primary current in London or Hongkong, without any wire connection or cable. Practically, there are some slight difficulties, such as the curvature of the earth and the length of the vertical wires requisite, and if we were telegraphing secret messages they could be read by any one with a vertical wire and an electric bell outfit.

Attempts were made first to induce currents at a distance by what may be called the coil or loop method, and this is still under investigation by a very eminent professor.

It is a method doomed to failure at comparatively short distances for two simple reasons.

The science of vertical wire telegraphy is the same as that of the common transformer or induction coil, and so is the science of the loop or coil telegraphy. In the latter case we set up a primary coil at A, and at B a secondary coil, where we wish to receive messages from A. The space between is the magnetic circuit, a bit longer than usual in transformers, and a good deal larger in cross-sectional area than in iron-cored transformers, a circuit about as long as Liverpool and as great in area has been used.

The simplest coil is a single turn or loop ⊓. If we set up two coils, O O and generate alternating currents in one, an alternating current will be set up in the other, and if the magnetic circuit is of low resistance and the one loop equal to the other, the induced electro-motive forces will be equal to the inducing electro-motive force in the primary loop, always provided the whole of the induced magnetic flux passes through both loops.

Now the electro-motive force generated in a coil of wire through which the induction varies is equal to the product of the number of turns multiplied by the rate of change of magnetic flux density. Expressed by Mr. Weeks as $E = 4.45\ F\ r\ n\ 10^{-8}$. F is the total flux, r the number of turns in the coil, n the frequency of alternations, 10^{-8} to reduce to volts.

Now, in a transformer with the primary a few miles from the secondary loop the amount of the magnetic flux which reaches the secondary can not be much more than a very small fraction of the whole, and the fraction which does reach it is not all effective, for it cuts both sides of the coil in the same direction, partially neutralizing each other.

4.45 is constant in value, F is naturally exceedingly small; r, for reason to be seen presently, can not be more than one turn, or, better still, as Marconi has it, should be half a turn, the only factor left us to increase, to keep up the induction at a great distance, is n, the frequency ∼. The higher the frequency the greater the distance we can operate.

Now high frequency can not be worked through loops and coils. For at quite limited frequency a loop or coil opposes enormous resistances against high frequency electro-motive force, and the current passing is reduced to almost zero. And as F depends on current value, we soon reach a frequency at which any further increase is counteracted by the decrease in current, even in single loop, *vide* Tesla's results.

For these reasons the loop or coil method is limited to low frequency, and consequently short distances.

Naturally, one at once says: "But we must have a loop to procure a current; it must go in one end and out the other;" that is so, for continuous currents; these must have on outgoing and return, a complete circuit.

But alternating currents can be sent up and down a single wire with no metallic return. All we require is a capacity at the top of a vertical wire, and an alternating charging + and −, or + and 0 (zero) at the lower end; every charge at the lower end rushes up the wire as an electric current and charges the ball, or capacity at the top, when the charge at the lower end is discharged or reversed, a current rushes down from the capacity ball at the top. Here we have an alternating current produced in a single wire, and it is this current which induces F magnetic force waves to act on the distant wire.

The reason why the wire must be long is that length takes the place of r in the formulæ; that is, instead of terms we would make d the length in centimeters or feet.

Both electro-static and electro magnetic induction takes place in setting up currents in a single wire.

With high frequency the inductive effects near a single wire are startling and interesting.

The spark discharge has been looked upon as an essential in single vertical wire telegraphy, but it is not so; it is used simply because it is at present the simplest and most effective method of producing very high frequency charges and discharges; the induction magnetic flux from the spark itself is in the form of a thin disk, the axis of which is the spark; the spark acts for the instant of its duration as a current.

Other methods of producing high-frequency currents in a single wire will occur to many electricians. The sending and receiving wires are simply the primary and secondary of a transformer. The currents produced in the secondary are too minute, and of too high frequency to be received in any magnetic or electric instruments; but, luckily for vertical wire telegraphy, Branly invented his coherer. This simple apparatus makes an excellent relay, and has been adopted in all the long-distance work—an impossibility without it.

There is no mystery about the long vertical wire; the mystery is, why should any one use a loop and low frequency?

The new Wehnelt interrupter and improved spark-producing apparatus may make great advances in the near future.

It seems to the writer very strange that nothing better than the rude, inefficient induction coil of 50 years ago should be the thing used for the high-frequency current-generating apparatus.

They may be very simple, but they are costly and not durable machines in everyday constant use.

If the wire is horizontal, there is little or no effect, probably because of the inductive effects of the earth, through which one-half of the magnetic flux would pass; the electrostatic induction would also be disturbed by the proximity of the earth to a horizontal wire.

The question is, what is the limit to be placed on the frequency of the current in the vertical wire, and what is its impedance to high frequencies?

No part of a single wire can be cut by its own magnetic flux. With a loop the flux from one side cuts across the wire on the other side, causing much impedance with high frequency.
—*London Electrical Review.*

The National Electric Light Association.

TO THE EDITOR OF ELECTRICAL REVIEW:

The Trunk Line Association, the Central Passenger Association, the Southeastern Passenger Association and the New England Passenger Association have granted a rate of a fare and one-third on the certificate plan, from points in their territory and return, for delegates and friends attending the twenty-second convention of this association, to be held in this city, May 23, 24, 25.

The following gentlemen will have charge of transportation matters for their several localities: Mr. W. Forman Collins, 510 Marquette Building, Chicago, Ill.; Mr. H. A. Wagner, Missouri Edison company, St. Louis, Mo.; Mr. C. F. Hesser, Cincinnati Gas Light and Coke Company, Cincinnati, Ohio; Mr. Morris W. Mead, city electrician, Pittsburgh, Pa.; Mr. R. F. Ross, 620 Atlantic avenue, Boston, Mass; Mr. H. B. Cutter, 1112 Sansom street, Philadelphia, Pa.; Mr. S. C. D. Johns, Cleveland Electric Illuminating Company, Cleveland, Ohio; Mr. M. L. Stern, city electrician, Denver, Colo.; Mr. H. M. Atkinson, Georgia Electric Light Company, Atlanta, Ga., and Mr. E. R. Weeks, Kansas City Electric Light Company, Kansas City, Mo.

Yours very truly,
C. O. BAKER, JR.,
Master of Transportation.

New York, April 26.

SEVENTH ANNUAL REPORT OF THE GENERAL ELECTRIC COMPANY.

REPORTS OF THE SEVERAL OFFICERS IN FULL.

The annual reports, in full, of the executive officers of the General Electric Company are published below, with a summary of the excellent financial condition of the company. These reports are all dated at Schenectady, N. Y., April 25, 1899, and will be read with interest by the electrical fraternity as a whole, and reflect the general prosperity in the industry:

PRESIDENT COFFIN'S REPORT.

The prosperity which has attended other lines of business during the past year has been shared by your company. The important extensions made to its factory plants during the past 18 months have proved to be most timely, and the company is now greatly benefited by the increased facilities they afford.

The matters of stock reduction and revaluation of the patent account of the company were brought to your attention in the last annual report. Since then a reduction has been made of 40 per cent in the share capital of the company, by vote of the stockholders at a meeting specially called for that purpose, the common stock being reduced from $30,460,000 to $18,276,000, and the preferred stock from $4,252,000 to $2,551,200. The patent account has been reduced from $8,000,000 to $4,000,000.

The profits for the year, after deducting all general patent and miscellaneous expenses, were	$3,896,884 10
Deduct deficit as of August 18, 1898, after reducing patent account and capital stock (see profit and loss account)	1,840,761 03
	$2,056,123 07
Less interest on debentures and current dividend on preferred stock	371,638 40
	$1,684,484 67
On January 31 there had been paid or charged against surplus all the old accrued dividends on preferred stock	1,527,913 68
Surplus January 31, 1899.	$156,570 99

Your careful attention is invited to the accompanying reports of the first, second and third vice-presidents.

The thanks of the directors and officers are due to the engineers, department managers and their associates for the untiring service rendered during the year, in which the demands upon them have been particularly severe.

By order of the board of directors,

C. A. COFFIN, President.

FIRST VICE-PRESIDENT GRIFFIN'S REPORT.

I submit herewith a brief report of the operations of the sales department for the fiscal year ended January 31, 1899.

Total sales (amount billed to customers)	$15,679,430 86
Cost of goods sold, general expenses and taxes, including sundry losses and allowances for losses	13,094,534 25
Profit on sales	$2,584,896 61

The increase over last year in orders received is 21 per cent. Apparatus orders represent 52 per cent of this increase, supply orders 39 per cent, incandescent lamp orders nine per cent. The increase in each class is:

Apparatus orders.....19% over last year.
Supply orders.....24% " " "
Incandescent lamp orders.23% " " "

Over 124,000 separate supply orders were received and over 8,400,000 incandescent lamps were ordered during the year.

About 89 per cent of the year's orders were on our standard terms—cash within 60 days.

ORDERS RECEIVED FOR THE PAST FIVE YEARS.

Fiscal year ended January 31, 1895	$12,160,119
Fiscal year ended January 31, 1896	13,235,016
Fiscal year ended January 31, 1897	11,170,319
Fiscal year ended January 31, 1898	14,382,342
Fiscal year ended January 31, 1899	17,431,527

The local office stocks are maintained in good saleable condition. The annual inventory shows these stocks classified as follows:

Active	92.5%	$442,380 43
Inactive	6.5%	30,666 60
Obsolete	1.0%	4,976 01
Totals	100.0%	$478,023 04

The improvement in this respect is shown by the following comparisons:

LOCAL OFFICE STOCKS FOR PAST FIVE YEARS.

	1895.	1896	1897.	1898.	1899.
Active	68%	82%	86%	90%	92.5%
Inactive	27%	14%	12%	8%	6.5%
Obsolete	5%	4%	2%	2%	1.0%

The past year shows the largest volume of business for the company for any fiscal year since its organization. The increase is well distributed, as shown above.

During the past year large powerhouses have been constructed or projected in or near many of our large cities, which power plants are centers of distribution of the electric current for railway, lighting and many other and constantly increasing uses and applications. The establishment of such large stations will result in decreased cost and increased use of electrical power.

The utilization of water powers by electrical transmission has also been a marked feature of the past year, and the successful transmission of electrical power over the 80-mile line of the Southern California Power Company, at Los Angeles, Cal., is the long-distance record to date of commercial transmission.

Some of the more important water-power transmission plants which have been sold by this company are given in the following table:

WATER-POWER PLANTS OVER TEN MILES TRANSMISSION.

Total Horse-Power.	Power used at	Transmission Distance in Miles.	Voltage.
1670	Redlands, Cal.	21	10,000
3000	Portland, Ore.	14.5	6,000
4000	Sacramento, Cal.	22.5	11,000
2000	Pachuca, Mex.	19	10,600
1407	Fresno, Cal.	55	19,000
2667	Salt Lake City.	14	10,000
1206	Bakersfield, Cal.	16	10,000
5000	Ogden and Salt Lake City.	40	15,000
800	Hookset, N. H.	10	10,000
1440	Cordova, Argentine Repub.	16	10,600
1000	Varese, Italy.	14	5,000
4000	Los Angeles, Cal.	80	33,000
2000	Provo, Utah.	40	40,000
5000	Schenectady, N. Y.	19	12,000
4000	Butte, Mont.	21	15,000
235	Tuscarora, Nev.	10	11,000
300	Cripple Creek, Colo.	10	6,300
1000	Hiroshima, Japan.	15	11,500
8000	Minneapolis, Minn.	10	11,000
670	North Gorham, Me.	14	10,000
800	Kingston, Jamaica.	21	16,000
400	Trenton, Can.	12	11,000
2000	West Kootenay, B. C.	20	20,000
765	Victoria Goldstream, B. C.	12.6	10,000

Many of these lines have been in operation for several years, and we have yet to learn of a fatal accident resulting from the use of such high voltages. This record is in striking contrast with the popular expectation and fear expressed as to the results when such lines were first proposed.

The Spanish war led to an increase in our business in the items of searchlights, cables, marine dynamo sets, etc., considerable as to each item, but small in proportion to our total business.

The increased business of the past year has considerably increased the burden upon our department and local office managers and selling agents, whose faithful and efficient work is deserving of commendation.

Respectfully submitted,

EUGENE GRIFFIN,
First Vice President.

THIRD VICE-PRESIDENT RICE'S REPORT.

I submit herewith a report on manufacturing and engineering for the fiscal year ended January 31, 1899.

The method of determining our factory costs, which has proved satisfactory in previous years, has been continued during the present year, such factory costs including all material and labor, plus a percentage to cover general expense items and an ample allowance for depreciation. The inventories have been most carefully taken. Financial statistics relating to factory investment are given in the report of the second vice-president.

Large additions have been made to our manufacturing plant and others are now in progress.

At the Schenectady works the large iron foundry mentioned in last year's report as in course of erection was completed last Summer, and is now fully occupied.

A brick and steel machine shop, covering three and one-fourth acres (142,000 square feet), was begun last June, and is now being equipped with the necessary machinery. This large shop will provide unsurpassed facilities for the economical production of the largest apparatus, the demand for which is increasing steadily.

Extensions amounting to about 40,000 square feet have been made to other existing buildings, including a suitable building for the safe storage of our valuable patterns.

At the Lynn works the capacity of the steel foundry has been increased 40 per cent, and we have in construction a new building for the manufacture of meters and instruments, the total addition amounting to 35,000 square feet—all substantial, well lighted brick buildings.

At the Harrison works we have, in order to meet the increased demand for incandescent lamps and to improve our facilities, started a new fireproof four-story building, containing about 60,000 square feet, which will be completed this Summer.

The area of the factory buildings now in use aggregates 1,800,000 square feet (41.3 acres enclosed), and the number of employés now at work is about 9,000.

In addition to the buildings mentioned, we have expended about four hundred thousand dollars ($400,000) for machinery and tools in the complete equipment of the new buildings, and to maintain existing machinery at the point of maximum efficiency and economy.

The demand for electrical machinery of large capacity and special design has continued to increase. A number of the great electrical generators (5,000 horse-power) for the new station of the Metropolitan Traction Company at New York have been completed, and we have under construction an additional order for similar machines, including the transformers and rotary converters to be used in transforming the alternating current into continuous current for the operation of the electric street cars in the Borough of Manhattan.

The equipment by us of the Buffalo & Lockport Railway with electric locomotives for handling freight, and motor cars for passenger service, is interesting as an instance in which the steam locomotive has been completely displaced by electricity both for freight and passenger service.

The number of installations using alternating generators, in a single generating station, and supplying through our rotary converters, located at convenient distributing points, continuous current for light and power, as described in my last report, has been added to during the year by installations at Philadelphia, Boston and other places.

Plants involving the transmission of electricity to long distances have continued to increase in number, those already in operation having been found economical and reliable.

We have now in operation about 40 long distance transmission plants, employing potentials of from 10,000 to 40,000 volts and transmitting power from 10 to 80 miles.

About two-thirds of the power re-

quired for operating our Schenectady works is now regularly supplied from a water-power at Mechanicsville on the Hudson River, 19 miles away; the production of electricity at high pressure directly in the stationary armature winding of the generators used in this transmission has, as anticipated, been successful, and has been followed in other similar installations because of its economy and simplicity.

A notable illustration of the flexibility of long-distance electric transmission is to be found in the supply of Salt Lake City with electricity from two generating plants, located some 50 miles from each other, the energy being united so as to simultaneously supply electricity over the same set of mains.

The St. Anthony Water Power Company's plant, mentioned in my previous report, has operated so successfully since its installation that additional apparatus to bring the total up to about 10,000 horse-power has been ordered during the past year.

The apparatus for use in the 80-mile transmission to the city of Los Angeles, Cal., mentioned in my last report, has been in successful operation for some months.

Many important orders for electric locomotives, large generators, etc., have been secured in competition with various European manufacturers.

Confidence in the reliability of electrical apparatus is now well established, and a general appreciation of its simplicity, flexibility and economy has resulted in a rapid increase in the use of electric motors in older fields and the opening of new. Electric motors are therefore being used in increasing numbers for the driving of machine tools in large and small factories, presses in printing establishments, for ventilating, pumping and mining operations. We have designed many motors specially adapted for such work during the past year.

Our engineers have been actively engaged during the past year in developing the apparatus and details required in new work and in improving and reducing the cost of existing standard lines of apparatus. Numerous improved forms of transformers, arc lamps, meters and instruments have also been introduced.

We have continued to protect our new designs as far as possible by applications for letters patents.

The work of our factory managers and engineers is worthy of the highest commendation.

Respectfully submitted,
E. W. RICE, JR.,
Third Vice-President.

SECOND VICE-PRESIDENT ORD'S REPORT.

The balance sheet and statement of profit and loss, herewith transmitted—with explanations of the items on the balance sheet—include the assets and liabilities and profit and loss accounts of the Edison General Electric, Edison Electric Light and Thomson-Houston Electric companies (which, for convenience of bookkeeping, are consolidated with those of the General Electric Company) at January 31, 1899; and when "the company" is spoken of all the above-mentioned corporations are included.

ASSETS.

PATENTS, FRANCHISES AND GOOD-WILL.

These were carried in the last three annual reports at		$8,000,000 00
During the year there was expended for acquiring new patents and in patent litigation		269,440 41
Total patent account		$8,269,440 41
By a vote of the directors there was charged to profit and loss on June 30, 1898, one-half the then book value of patents, viz.	$4,000,000 00	
Now written off to profit and loss	269,440 41	$4,269,440 41
Leaving the patents, franchises, good-will, etc, of the company standing on its books at the date of this report, [as per balance-sheet, at		$4,000,000 00

FACTORY PLANTS.

This account represents the real estate (lands and buildings), machinery, tools, appliances, etc., patterns, drawings, etc., and sundries (fittings and other small property accounts) of the manufacturing plants at Schenectady, N. Y.; Lynn, Mass., and Harrison, N. J.

The lands of all three plants now amount to about 160 acres, and the total factory floor space of all their buildings is approximately 1,800,000 square feet.

All are free from mortgage or other lien.

In the last annual report it was estimated that certain extensions to the Schenectady plant would cost about $500,000. The company's increased business has necessitated much larger additions to its manufacturing capacity, both at Schenectady and Lynn, than were then projected, and $786,000 have been expended during the past year in enlargements, new buildings, improvements and machinery. The cost of these additions has been charged against the general earnings of the company, as have also all expenditures for the maintenance and repair of buildings and machinery, plus an allowance to provide for depreciation.

A summary of the changes in this account since the last annual report is as follows:

Balance as per last report	$4,000,000 00
Add charges during the year	786,440 41
Deduct amount written off	269,440 41
Balance as per balance-sheet	$4,517,000 00

In the above settlements of old debts there was realized $49,799.21 over last year's book valuations, less $4,982.41 loss in settling a few debts below their appraised value. Net gain above appraised value, $44,816.80.

The sales of the last three months of the year amounted to $4,151,904.62.

"DOLLAR" NOTES AND ACCOUNTS.

There yet remain—of the $2,432,860.88 old notes and accounts receivable which three years ago were written off to profit and loss, except the nominal book value of $1 for each debtor—notes and accounts of 131 debtors aggregating $1,374,703.69. These stand on the books at a total of $131, and are being liquidated gradually.

The total amount realized from this class of notes and accounts by settlements made during the past year was $62,190.62.

WORK IN PROGRESS.

This account does not include outlays for anything in process of manufacture at the factories, but represents expenditures for labor, material, etc, at cost, on 315 uncompleted installations of finished apparatus in progress at various places. $774,965 67

Less partial payments thereon, received under the terms of the contracts as work progressed. 267,629 72

Balance as per balance-sheet. $507,335 95

SCHEDULE A—STOCKS.

Corporate Name.	Address.	Par Value.
Augusta Railway and Electric Co.	Augusta, Ga.	$100,000
Boston & Revere Electric Street Railway Co.	Boston, Mass.	11,900
Buffalo General Electric Co.	Buffalo, N. Y.	110 000
Binghamton General Electric Co.	Binghamton, N. Y.	6,300
British Thomson-Houston Co., Limited	London, Eng.	54,350
Cie d'Electricite T.-H. de la Mediterranee.	Paris, France.	210,000
Compagnie Francaise, etc., T.-H.	Paris, France.	48,125
Chattanooga Light and Power Co.	Chattanooga, Tenn.	125,000
Cincinnati Edison Electric Co.	Cincinnati, Ohio.	290, 66
Citizens' General Electric Co. (Pref.)	Louisville, Ky.	67,900
" " " (Com.)	" "	267,300
Consolidated Electric Light Co.	Birmingham, Ala.	215,000
Cleveland Electric Illuminating Co. (Pref.)	Cleveland, Ohio.	61,600
" " " " (Com.)	" "	187,000
Chicago Edison Co.	Chicago, Ill.	158,600
Columbus Edison Electric Light Co.	Columbus, Ohio.	20,900
Canadian General Electric Co. (Com.)	Toronto, Can.	650,000
Des Moines Edison Light Co.	Des Moines, Iowa.	447,880
Edison Illuminating Co.	Easton, Pa.	4,250
" Electric Illuminating Co.	Paterson, N. J.	31,500
" " " "	New York, N. Y.	276,230
" " " "	Cumberland, Md.	8,500
" " " "	Altoona, Pa.	10,000
" " " " (Com.)	Baltimore, Md.	100,000
" " " " (Pref.)	" "	50,000
" " Light and Power Co.	Kansas City, Mo.	14,200
" " " "	Erie, Pa.	14,400
" " Co.	York, Pa.	13,200
" Light Co. of Grand Rapids.	Grand Rapids, Mich.	24,000
" Electric Co. (Pref.)	New Orleans, La.	1,991,800
" " (Com.)	" "	1,000,000
Elgin C. Carpentersville & Aurora Railroad Co.	Elgin, Ill.	25,000
Ellsworth Electric Illuminating Co.	Ellsworth, Me.	27,350
First Cincinnati Edison Electric Illuminating Co.	Cincinnati, Ohio.	8,700
Fall River Electric Light Co.	Fall River, Mass.	9,000
Johnstown Electric Light Co.	Johnstown, Pa.	18,900
Kingston Electric Co.	Kingston, N. Y.	43,650
Kansas City Suburban Belt Line Railroad Co.	Kansas City, Mo.	4,100
Kansas City, Pittsburgh & Gulf Railroad Co.	" " "	1,750
Laramie E. G. L. and F. Co.	Laramie, Wy.	16,500
Marshfield Electric and Gas Co.	Portland, Ore.	10,500
Mexican General Electric Co.	Schenectady, N. Y.	50,000
Missouri Edison Electric Co.	St. Louis, Mo.	20,000
Newport Illuminating Co.	Newport, R. I.	36,700
Otis Electric Co.	Yonkers, N. Y.	174,000
People's Electric Light and Power Co.	Oswego, N. Y.	104,000
Portland General Electric Co. (Com.)	Portland, Ore.	627,800
Rutland City Electric Co.	Rutland, Vt.	58,500
Raleigh Electric Co.	Raleigh, N. C.	9,000
Schenectady Railway Co.	Schenectady, N. Y.	188,100
South African General Electric Co.	" " "	50,000
Scranton Illuminating, Heat and Power Co.	Scranton, Pa.	42,000
Thomson-Houston Electric Light and Power Co.	Quincy, Ill.	2,[illegible]
Union Electric Co.	Seattle, Wash.	50,000
Union Elektricitats-Gesellschaft	Berlin, Germany.	40,460
United Electric Securities Co. (Pref.)	Boston, Mass.	27,300
" " " " (Com.)	" "	500,000
Utica Belt Line Street Railroad Co. (Pref.)	Utica, N. Y.	50,000
Total		$8,831,411

Total book value. $3,801,827.41

Average per cent of book value of above-named stocks to par, 43.05.

NOTE.—The corresponding per cent of stocks in the last annual report was 45.39.

ALLOWANCES FOR POSSIBLE LOSSES.

	Notes receivable.	Accounts receivable.	Total.
On debts existing at the end of last year there was then allowed	$343,895 52	$318,719 14	$662,614 66
Amount of such allowance absorbed during the year in effecting settlements of old debts	76,559 10	107,979 40	184,538 50
Balance of allowance still standing on the old debts	$267,336 42	$210,739 74	$478,076 16
Above allowance is now increased	0	67,007 47	67,007 47
Total allowance on old debts	$267,336 42	$277,747 21	$545,083 63
Allowance for possible losses on new debts	30,793 58	144,535 72	175,329 30
Present allowance for possible losses	$298,130 00	$422,282 93	$720,412 93
Total face value as above	1,493,630 99	4 313,330 76	5,806,961 75
			$5,086,548 82
Add book value of "dollar" notes and accounts			131 00
Total book value as per balance-sheet.	$1,195,500 99	$3,891,047 83	$5,086,679 82

None of the estimated profit to be derived from these installations is included in the earnings of the year.

INVENTORIES.

These accounts represent actual inventories—counted and valued item by item—of raw materials and goods manufactured and in process of manufacture at the factories; of manufactured goods in storerooms of local offices and on consignment; of office furniture, fixtures, instruments, etc., in the general office and in local offices; of machinery, tools and materials in local repair shops; and also of shipments in transit to local storerooms.

Raw materials have been valued at or under the market prices prevailing on January 31, 1899; active-selling finished and partly finished apparatus and supplies at factory cost; inactive or slow-selling apparatus and supplies at about 50 per cent of factory cost; obsolete apparatus and supplies at scrap value; and furniture, machinery, tools, instruments, etc., at present value.

FACTORIES.

On the above basis, the inventories of the factories exceeded their book value. Following the practice of previous years, however, the whole of such excess has not been taken as a part of this year's profit, but a

portion has been retained as a reserve against increased cost of manufacturing, due to the advance in prices of raw materials.

The increase of nearly $1,000,000 over last year's factory inventories is a natural result of the accumulation of work in process at the factories, due to the growth of the company's business.

GENERAL AND LOCAL OFFICES.

The inventories of apparatus and supplies in all local offices showed a shrinkage from book value of $26,153.47, which has been written off as a loss for the year.

During any year goods are taken in and out of local office inventories at the factory mainder represents apparatus on exhibition or loaned to regular customers for temporary use by them.

All such shipments are charged to this account at factory cost.

Their total is	$83,288 48
Less allowance for depreciation,	30,424 18
Net book value of consignment as per balance sheet	$52,864 30

LIABILITIES.

The company has no note payable, nor is there under discount any paper bearing the company's indorsement or guarantee.

It has not borrowed any money, nor has the company's credit been used during the year either by issuing notes, indorsing customers' paper for discount or lending its name in any way, but, by adhering to the policy of the previous four years and maintaining sales on a basis of cash or short credit to desirable customers, all purchases have been paid for in cash.

DEBENTURES.

During the year the company has purchased and canceled $300,000 of its own five per cent gold coupon debentures, due June 1, 1922, at an average cost of 99.19 per cent.

ACCRUED INTEREST ON DEBENTURES.

This account, as its name implies, is the full amount of five per cent interest accrued to January 31, 1899, on the company's $5,700,000 outstanding debentures.

ACCOUNTS PAYABLE.

This account includes all unpaid audited indebtedness.

At the close of business on January 31, 1899, the unpaid bills on hand—none of which was then due under the terms of purchase—amounted to..... $146,195 19

Between January 31 and February 27, 1899, the date of closing the general books, additional expenditures belonging to the past year were audited, amounting to..... 285,301 25

Total as per balance sheet... $431,496 44

The amount of unpaid vouchers which is carried over in this way monthly (by keeping the books, other than the cash-book, open a sufficient time to include each month's expenditures in that particular month) is usually about $500,000.

Respectfully submitted,
J. P. ORD, Second Vice-President.

SCHEDULE E—BONDS.

Corporate Name.	Address.	Par Value.
Astoria Street Railway Co.	Astoria, Ore.	$16,000
Ashland Light, Power and Street Railway Co.	Ashland, Wis.	110,000
Ashville Electric Co.	Asheville, N. C.	15,000
Bangor Electric Light and Power Co.	Bangor, Me.	67,500
Benton Power and Traction Co.	Sauk Rapids, Minn.	7,000
Brush Electric Co.	Cleveland, Ohio.	369,000
Binghamton General Electric Co.	Binghamton, N. Y.	2,000
Carpentersville, Elgin & Aurora Railway Co.	Elgin, Ill.	1,000
City Park Railway Co.	Tacoma, Wash.	120,000
City of Ocala	Ocala, Fla.	1,800
Columbus Railroad Co.	Columbus, Ga	43,000
Charleston Edison Light and Power Co	Charleston, S. C.	125,000
Chillicothe Electric Railway, Light and Power Co.	Chillicothe, Ohio.	28,250
Dayton Electric Light Co.	Dayton, Ohio.	62,000
Des Moines Edison Light Co.	Des Moines, Iowa.	11,000
Des Moines Water-Power Co	Des Moines, Iowa.	17,000
Dedham Electric Co.	Dedham, Mass.	47,000
Edison Electric Co.	New Orleans, La.	1,141,000
Edison Electric Co.	Los Angeles, Cal.	5,000
Fort Wayne Consolidated Railway (Receiver's Certificate)	Fort Wayne, Ind.	10,150
Fort Worth Street Railway Co	Fort Worth, Tex.	9,000
Gallitzen Electric Light Co	Gallitzen, Pa.	7,000
Geneva Power and Light Co.	Geneva, N. Y.	49,000
Jackson Light and Power Co.	Jackson, Mich.	32,000
Kansas City, Pittsburgh & Gulf Railroad Co.	Kansas City, Mo.	3,000
Kings County Electric Light and Power Co.	Brooklyn, N. Y.	37,500
Little Rock Traction and Electric Co.	Little Rock, Ark.	77,000
Memphis Light and Power Co.	Memphis, Tenn.	29,000
Mahoning Valley Railroad Co.	Youngstown, Ohio.	149,000
Madison Electric Railway Co.	Madison, Wis.	22,000
Narragansett Pier Electric Light and Power Co.	Narragansett Pier, R. I.	1,000
Newport Illuminating Co.	Newport, R. I.	22,500
New Orleans & Western Railroad Co. (Receivers' Certificates)	New Orleans, La.	18,181
Northern Railway and Improvement Co.	New Whatcom, Wash.	50,000
North River Electric Light and Power Co.	New York, N. Y.	2,000
Oxford Lake Line	Anniston, Ala.	175,000
Otis Electric Co.	Yonkers, N. Y.	10,000
Oshkosh Electric Light and Power Co.	Oshkosh, Wis.	5,000
Plymouth Electric Light Co.	Plymouth, Mass.	51,000
Portland General Electric Co.	Portland, Ore.	29,000
Phœnix Electric Light Co.	Phœnix, N. Y.	3,000
Public Works Co.	Bangor, Me.	264,000
Peoples' Electric Light and Power Co.	Oswego, N. Y.	85,000
Pueblo Electric Street Railway Co.	Pueblo, Colo.	19,000
Peninsula Lighting Co.	Redwood City, Cal.	2,100
Penobscot Water and Power Co.	Penobscot, Me.	10,000
Raleigh Electric Co.	Raleigh, N. C.	6,000
Rochester Railway Co.	Rochester, N. Y.	35,000
Rutland City Electric Co.	Rutland, Vt.	28,000
Sacramento Electric Gas and Railway Co.	Sacramento, Cal.	257,000
Schenectady Railway Co	Schenectady, N. Y.	117,000
Seneca Light and Power Co.	Seneca Falls, N. Y.	53,500
Tacoma Railway and Motor Co.	Tacoma, Wash.	630,000
Tonawanda Lighting and Power Co.	Tonawanda, N. Y.	14,500
Twin City General Electric Co.	Ironwood, Mich.	15,000
United Gas and Electric Co.	Dover, N. H.	20,000
Utica Belt Line Street Railroad Co	Utica, N. Y.	5,000
West Street and North End Electric Railway Co.	Seattle, Wash.	64,000
Winona Railway and Light Co.	Winona, Minn.	36,000
Water, Light and Power Co.	St. Cloud, Minn.	2,500
Total		$4,914,131

Total book value..... $3,182,948.03

Average per cent of book value of above named bonds to par, 64 77.

NOTE—The corresponding per cent of bonds in the last annual report was 66.27.

CONSOLIDATED BALANCE SHEET OF JANUARY 31, 1899.

ASSETS.			LIABILITIES.		
Patents, franchises and good-will. ...		$4,000,000 00	Capital stock: 7% cumulative preferred..	$2,551,200 00	
Factory plants.....		3,400,002 00	Common.....	18,276,000 00	
Real estate (other than factory plants)		615,084 72			$20,827,200 00
Stocks and bonds.....		7,226,422 45	5% gold coupon debentures		5,700,000 00
Cash.....	$1,942,967 21		Accrued interest on debentures.....	47,500 00	
Less amount in banks set aside to pay final accumulated dividend ($19 05% per share) on preferred stock.....	486,173 68*		Accounts payable.....	431,496 44	
		1,456,793 53	Unclaimed dividends .	11 739 14	
Notes and accounts receivable.....	5,086,679 82				490,735 58
Work in progress.....	507,335 95				
	5,594,015 77				
Inventories:					
Factories...	$4,223,033 93				
General and local offices .	666,339 87				
Consignments...	52,864 30	4,882,238 10			
		10,476,253 87	Profit and loss.....		156,570 99
		$27,174,506 57			$27,174,506 57

*As a dividend of this amount was declared on February 10, 1899, and paid on March 8, 1899, it is anticipated and deducted here, and charged off in the profit and loss statement for the year.

CONSOLIDATED PROFIT AND LOSS ACCOUNT OF JANUARY 31, 1899.

DR.			CR.		
Balance January 31, 1898 (deficit).....		$11,725,561 03	Reduction of capital stock August 17, 1898:		
Reduction of book value of patents, franchises and good-will, June 30, 1898.....		4,000,000 00	Preferred stock—reduced 40 per cent....	$1,700,800 00	
			Common stock—reduced 40 per cent....	12,184 000 00	
					$13,884 800 00
			Balance carried down.....		1,840,761 03
		$15,725,561 03			$15,725,561 03
Balance brought down (deficit).....		$1,840,761 03	Sales	$15,679,430 86	
Cost of goods sold	$11,275,612 18		Royalties and sundry profits.....	792,590 82	
General expenses, taxes, sundry losses and allowances for losses....	1,818,922 07				$16,472,021 68
		13,094,534 25	Dividends and interest received on stocks and bonds owned	341,999 76	
Patents and patent expenses.....		269 410 41	Interest and discount...	119,953 61	
Interest on debentures*.....		290,000 00			461,953 37
Dividends on preferred stock:					
All accumulated dividends, viz:					
From July 1, 1893, to Dec. 31, 1896—paid..	$1,041,740 00				
From Dec. 31, 1896 to Aug. 17, 1898—payable March 8, 1899.	486,173 68†		Profit on sales of stocks and bonds.....	$321,462 03	
Current 7 per cent dividend from Aug. 17, '98, to Jan. 31, 1899—paid.	81,638 40		Discount on debentures purchased and canceled.....	2,421 68	
		1,609,552 08			326,883 71
Balance January 31, 1899 (surplus)...		156,570 99			
		$17,260,858 76			$17,260,858 76

*On $6,000,000 for four months and on $5,700,000 for eight months.

†See foot note to balance sheet.

E. & O. E. J. P. ORD, Second Vice-President.

Experiments with Wireless Telegraphy in Chicago.

Several experiments with the Marconi system of wireless telegraphy have recently been conducted in Chicago under the direction of Prof. Jerome K. Green, of Notre Dame University. Professor Green was assisted by several experts from the Chicago Telephone Company, the city electrician and telegraph companies' representatives. Demonstrations were made of the practical use of the invention on land. Messages were successfully transmitted from the office of the Chicago *Tribune* to the Marquette Building, fully two blocks away. On April 23 the experiment was tried successfully of sending messages from the United States Life Saving Station to the tug "Protection," a distance of two miles out on the lake. The test actually demonstrates the practicability of using the system for sending telegraphic messages on sea and land. Professor Green will remain in Chicago and a public test will be given later under the auspices of the *Tribune*.

The secretary, M. F. Westover, announces with the report of the stockholders that the annual meeting will be held at the company's office, Schenectady, N. Y., on Tuesday, May 9, at 12 o'clock noon, for the purpose of electing 13 directors for the ensuing year, and to transact such other business as may properly come before the meeting. The present books of the company closed at three o'clock P. M., April 12, and will be reopened at 10 o'clock A. M., Wednesday, May 10.

The annual report, published in full above, is for the fiscal year ended January 31, 1899.

ADVANCE INFORMATION

Increase of Capital.

BELLEFONTAINE, OHIO—The Bellefontaine Telephone Company has increased its capital stock from $10,000 to $25,000.

ST. LOUIS, MO.—The Lindell Street Railway Company has increased its capital from $2,500,000 to $10,000,000.

New Incorporations.

RICHMOND, VA.—The Tower-Binford Electric and Manufacturing Company has been incorporated, to manufacture certain articles necessary in the construction of plants, to equip the same, to wire buildings and to furnish all electrical supplies to the trade, with a capital stock of $30,000.

TRENTON, N. J.—The American Incandescent Light Company has been incorporated, with an authorized capital stock of $2,000,000. The company is to manufacture all kinds of incandescent and other lamps and fixtures and lighting apparatus and devices of every character. The incorporators are Charles S. Dickey, Harry A. Norton, Charles D. Burrage and Kenneth K. McLaren.

NEW YORK, N. Y.—The New York Electric Brake and Coupler Company, with a capital of $1,000,000, has been incorporated. The company is formed to manufacture electric brakes and couplers of all kinds.

WILMINGTON, DEL.—O'Kelly Electric Contract Company, of New York; capital, $75,000.

Electric Light and Power.

CANNELLTON, IND.—The Cannellton Electric Light and Power Company, with a capital stock of $5,000, has been incorporated; directors, C. H. Walls, J. C. Adair and Louis Adair.

VICTOR, COLO.—The Woods Investment Company is contemplating the erection of an electric plant at this place. The plant is to furnish power for the propelling of ore cars through the Columbine-Victor tunnel. It is the intention of the company to run the ore from the Gold Coin mine through the tunnel for treatment at the Economic Gold Extraction mill, now in course of construction at Eclipse gulch. The tunnel will be completed within four months.

CARTHAGE, ILL.—G. Jaeger & Company, of Rich Hill, were awarded the contract for building the municipal light and power plant for the sum of $25,125.

WILKESBARRE, PA.—The People's Electric Light and Power Company has been granted a charter, and it is understood that application will be made immediately to the council for rights to erect poles throughout the city. The new company promises to build a new and modern lighting plant, and to supply light at a rate much lower than the present price. It is stated that a large central station will be built outside the city, where coal and water can be secured to the best advantage, and that one or more substations will be built in the lighting district. The alternating system will be used. The members of the new company are T. F. Ryman, president; Jacob Roberts, Jr., treasurer; Maurice Gaertner, S. J. Tonkin and R. M. Hughes, directors. It is estimated that $200,000 will be expended in the enterprise.

New Telephone and Telegraph Companies.

OAKLAND, MD.—A telephone line has been completed connecting Oakland with Friendsville, Selbyport, Thayersville, McHenry, Accident and other towns in the northern portion of Garrett County, as well as a number of Pennsylvania and West Virginia towns. State Senator Robert A. Ravenscroft is constructing a line from Accident to Cove, Garrett County. An extension from the Maust Lumber Company's line to Grantsville, via Bittinger, is also in course of construction.

JAMESTOWN, IND.—The Citizens' Telephone Company has been incorporated; capital, $500; incorporators, J. O. Finch, C. F. Martin, Thos W. Porter, Justus Kerbaugh.

LONGMONT, COLO.—The Colorado Telephone Company has been granted a 20-year franchise by the City Council. The franchise makes it binding upon the company to extend its line to the towns of Lyons and Hygiene, in Boulder County, and Rinn and Highland Lake, in Weld. The new lines will be in active operation within four months from the passage of the ordinance.

FLORA, IND.—The Bringhurst & Flora Telephone Company, with a capital of $14,000, has been incorporated; incorporators, David E. Miller, Wilson Eikenberg, G. F. Shigley.

KEARNEY, NEB.—The Home Telephone Company has been incorporated; incorporators, Frank H. Gilcrist, C. W. Lloyd, J. S. Adair, W. E. Jakway and Warren Pratt.

RICHWOOD, OHIO—The Richwood Telephone Company, with a capital stock of $10,000, has been incorporated.

SALEM, N. J.—An effort is being made to establish a telephone line between this place and Pennsville.

DOVER, DEL.—The Boston & New York Telegraph and Telephone Company has been incorporated with a capital stock of $5,000,000. The incorporators are Z. S. Swift, J. Breed, Oakes Ames and Charles E. Adams, all of Boston.

ROSEVILLE, OHIO—The International Telephone Company has been incorporated; capital, $500; incorporators, George W. W. Walker, S. P. Zehrung, George W. Owen, L. S. Kildow, G. H. Bodine.

MARIETTA, PENN.—The Columbia Telephone Company is at work extending its line from this place to Bainbridge, a distance of seven miles. It will take in Miller & Musser's saw mill, Locust Grove and Rowenna. It is expected that the line will be completed for operation in two weeks.

New Electric Railways.

SAN JOSE, CAL.—A number of capitalists of this city have associated themselves together for the building of an electric railroad between this city and Alviso. At their head is ex-Supervisor A. Greeninger. It is proposed to carry freight on the road.

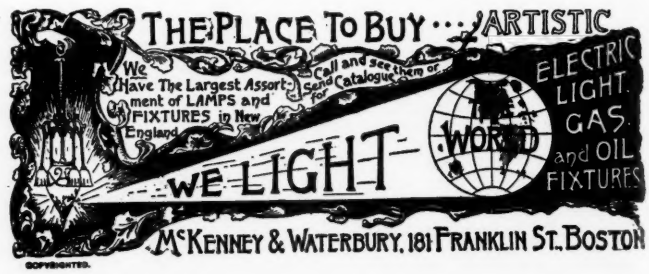
WILKINSBURG, PA.—Booth & Flinn have received the contract for constructing the Wilkinsburg & East Liberty Street Railroad for the Monongahela Street Railway Company. Work will commence at once and cars will be running by September 1. The new line will be four miles long and will run from this place to East Liberty through Edgewood, Swissvale, Hawkins and North Braddock.

DETROIT, MICH.—Franchises are now being secured for another electric railroad in Wayne County. It is proposed to run a line from this place to Belleville, passing through Taylor Center and Romulus. The promoters promise to have the road in operation three months after all the franchises have been secured.

WHEELING, W. VA.—The incorporation of the People's Railway Company, of Wheeling, at Charleston for the purpose of building and maintaining a street railway line in this city, indicates that the movement to establish a new and competing railway line is likely to assume material importance. The incorporators are Hon. Frank P. McNell, Dr. C. L. Hill, Dr. R. M. Rau, Mr. Gilmore Brown and Hon. John J. Coniff.

BENTON HARBOR, MICH.—A new franchise has been granted to the Benton Harbor & Eastman Spring Electric Street Railway, to be completed in 60 days. This new franchise means the connection of railway stations with the central part of the city by an electric line, also the adding of electricity to two miles of horse car line now in operation. This new electric line will run in connection with the already established electric line connecting the two cities.

TRENTON, N. J.—A charter has been granted to the American Railways Company, with a capitalization of $25,000,000. The incorporators are Frank R. Hansell, George H. B. Martin and William F. Edell, of Camden. The company is incorporated to construct and operate railroads all over the country.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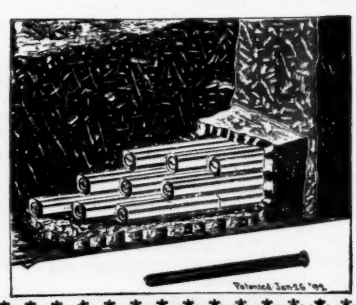

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